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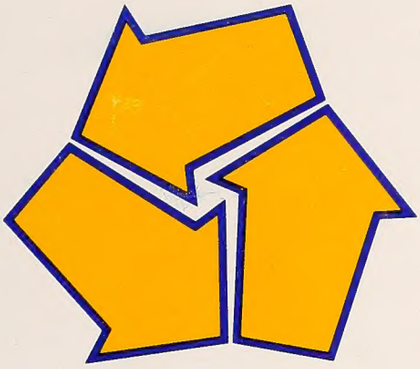

prospective rate setting in Indiana

Impact on Hospital Costs, Quality, and Management

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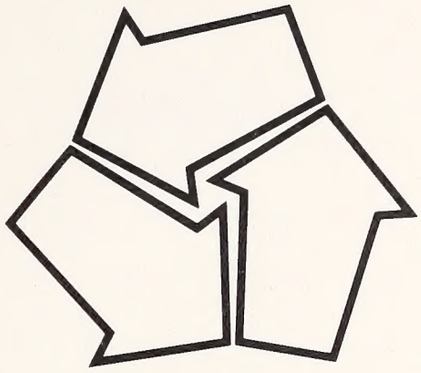

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Preface

The Spectrum Research study of the Indiana Prospective Rate Setting Program has three products. One is the main report, published in September 1978 and entitled Controlling Hospital Costs: The Revealing Case of Indiana. Another is the Summary of that report, which was completed in October of this year.

The third is this report which is the most comprehensive of the Indiana publications. Its purpose is to discuss in technical depth the study methodology and results. Like the other two reports, it is published by Policy Center, an organization associated with Spectrum Research.

In the main report we gratefully acknowledge the contributions of many individuals. While there is no need to repeat those acknowledgments here, it is necessary to correct several oversights. Fred Harrington designed the graphics for the Indiana reports. We have found Fred to possess that unique combination of creativity and flexibility. Alex and Mike Scott were responsible for the printing of the Indiana publications. They were not only easy to work with, but they exhibited a characteristic sometimes neglected, but in the end essential to human conduct: They were fully willing to stand behind their work.

As stated in the other two reports, the study conclusions and results are our responsibility, and should consequently not be ascribed to DHEW or other organizations.

Patrick O'Donoghue, MD
Tonie Gatch
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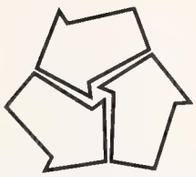
Nancy Hoffman Shanks

Denver, Colorado
November 1978



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I.

Introduction

The single chapter of this section is central to this report. It carries out two essential tasks.

First, after describing the policy context of this study, Chapter 1 discusses the study's general purpose, showing how this purpose flows directly from the policy context. Second, the chapter defines the seven specific objectives of this study. These objectives which emanate from the general purpose guided the conduct of this study.

1.
Purpose

Widespread consternation about hospital costs characterizes American life at the present time. At the most basic level two conditions are responsible. First, the hospital industry is large. In 1975 this industry alone -- excluding physician services -- consumed more than $50 billion, or about 3.5% of the gross national product.

Second, during the last quarter century hospital cost (average cost per case) has increased much more rapidly than consumer prices as a whole. In the United States, between 1950 and 1975 hospital cost rose by 817% compared to a 124% increase in the Consumer Price Index (CPI). As shown below, this sharp escalation in hospital cost is not a recent phenomenon. Instead, it has been present throughout this quarter century.[1]

	'50-55	'55-60	'60-65	'65-70	'70-75
Hospital Cost	41%	36%	41%	93%	74%
CPI	11%	11%	7%	23%	39%

Either of these conditions alone would not be sufficient to produce the current state of public concern. If the hospital industry were smaller, its rate of inflation would be much less consequential. Conversely, if its inflation rate were no higher than that of the general economy, its size alone would not create problems. However, these two conditions together have made the hospital industry a major focus of public attention.

A number of factors have contributed to the inflation in hospital costs. One is general inflation in the economy. Hospitals must purchase food, fuel, and other supplies; they must compete with other firms for personnel. Another factor is the progressive increase in the complexity of hospital services. Medical technology has changed dramatically during the last quarter century. Some changes have been cost saving, e.g., the invention of polio vaccines and probably the

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[1] Increases in cost per patient day, the other most commonly used hospital cost measure, are comparable to those shown for cost per case.

development of a wide array of antibiotics. Most have been cost increasing, with prominent examples being renal dialysis and open heart surgery.

A key inflationary factor is that the level of hospital insurance coverage has markedly increased during the last quarter century. At present more than 90% of the American population is covered by some form of hospital insurance, which often provides comprehensive benefits. By sharply reducing the effective price of hospital services to the consumer, insurance coverage gives a freer rein to other forces affecting the demand for hospital care.

Another contributing factor is the gulf between the hospital administrative staff and the physician staff. Neither is solely responsible for evaluating the important trade-offs between the cost and quality of hospital care. Nor is it common for the administrative and physician staffs to jointly consider such trade-offs. Still another inflationary factor is the underlying philosophy of providing the best care available to the sick individual, even if such care is clearly not cost effective from the viewpoint of society. This philosophy is generally accepted not only by physicians and other health care practitioners, but also by hospital administrators and board members. Moreover, it is a philosophy which most Americans would be loath to give up.

Almost coincident with the rise in hospital cost inflation, analysts and policymakers have pointed to yet another factor which may strongly contribute to such inflation. It is the way hospitals are paid. In the early 1950s most hospitals were paid on the basis of charges for specific services, with the charges often bearing little resemblance to the costs of providing the services. Third-party payers seldom reviewed these charges and thus exerted little downward pressure on hospital costs. This approach of paying charges without review became steadily less tenable as insurance coverage expanded, thereby decreasing consumers' concern about the size of their hospital bills.

During the late 1950s and the 1960s there was a shift toward another hospital payment approach -- a movement sharply accentuated by the advent of the Medicare program in 1966. Termed retrospective reimbursement, this approach entails advancing hospitals interim payments for cash flow purposes and reaching final settlement on the basis of actual costs incurred during the preceding reporting period. Compared to paying hospital charges without review, this approach offers certain advantages. First, large paper profits can be eliminated since the hospital is paid its costs (often including a small margin) rather than its charges. Second, certain types of costs can be excluded, i.e., made unallowable by the third-party payer. Third, the very fact that hospital records are reviewed by an outside agency broadens the financial accountability of the hospital.

However, retrospective reimbursement has a major and perhaps fatal drawback. It offers hospitals no incentive to restrain costs. Instead, its incentives are in the opposite direction. As long as a cost can be categorized as allowable after the fact by the hospital, it is covered by the third-party payer.

Because of this drawback and the persistence of rapid hospital cost inflation, increasing emphasis has been placed on a third approach to hospital payment -- prospective rate setting.[2] Under this approach hospitals are paid on the basis of rates established in advance by the rate setting program.

Compared to retrospective reimbursement, prospective rate setting potentially confers important advantages by virtue of two fundamental characteristics. First, the financial incentives are reversed. Once the prospective rates are established, hospitals are to some degree at risk under most prospective rate setting programs. At a minimum such programs provide an incentive for the hospital not to exceed its projected budget which forms the basis for its rates.

Second, in most prospective rate setting programs the hospital budget and thus planned hospital actions are reviewed in advance. As a consequence, a much wider array of options are open to the program and the hospital. If a budget item is considered after the fact, the only options are to pay all, part, or none of the expenditure. Either of the latter options is necessarily punitive since the hospital has already expended the dollars. If the same item is reviewed before the fact, the hospital can decide to eliminate the expenditure if the program turns it down. Further, in response to a program decision the hospital can devise an intermediate option, such as increasing the number of personnel in a nursing unit, but substituting practical nurses for registered nurses.

Because of these characteristics, public favor has been increasingly bestowed on prospective rate setting. Programs based upon this approach have been established in a number of states.[3] However, despite the movement toward prospective rate setting, there is little sound analysis indicating that this approach realizes its potential advantages. To date, the prospective rate setting program most extensively studied has been the system in New York state, which was instituted in 1970. It was analyzed by both Cromwell et al. (1976a and 1976b) and

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[2] The terms prospective payment, prospective reimbursement, and rate review are often used to denote this payment approach. However, they are not as accurate as the term prospective rate setting. The latter term is thus emphasized in this report.

[3] Bauer has prepared a series of reports describing many of these programs. Her work in this area is summarized in Bauer (1978).

Dowling et al. (1976a and 1976b). These studies do not show that the New York program has been successful in controlling hospital costs. Further, Dowling supplies evidence suggesting that it has harmful side effects, especially in terms of depleting hospital financial resources.

Cromwell analyzed the impact of the New York program in Upstate New York, and Dowling examined its influence in Downstate New York. Both studies used regression analysis and time trend analysis to assess the impact of the New York program on hospital costs. While time trend analysis may often yield important insights, it is distinctly less accurate than regression analysis since it does not take into account the effects of other variables.

Dowling's time trend findings (discussed in Chapter 12) suggest that the New York program may have lowered hospital cost inflation. In partial contrast, Cromwell's time trend results do not imply a negative effect on hospital costs, but do suggest a negative impact on hospital revenues.

However, the regression analyses of both studies do not consistently demonstrate a negative cost impact which is statistically significant. Dowling's regression results are drawn from the period 1968 through 1974. They show that the New York program has an insignificant influence on hospital costs in the New York/Cleveland and New York/Philadelphia comparisons, but a significantly negative effect in the New York/Chicago comparison. Dowling summarizes his findings by stating:

> The consistent conclusion of the cost function analysis is that there are indications of a cost reduction effect coincident with the introduction of PR [prospective reimbursement] in Downstate New York, however, it is not possible to statistically isolate these effects from economy-wide effects exerting pressure in the same direction.

Based on the period 1965 through 1974, Cromwell's regression findings are similar. Derived in several different ways, they do not show in

any instance that the New York program has a significantly negative influence on hospital costs.[4,5]

Purpose of Study

This study's subject is another major prospective rate setting system -- the Indiana Program. It is a mature and serious program which has the following characteristics.

- The Program's purpose is to increase the efficiency of hospital care and to thereby decrease hospital cost inflation.
- The scope of the Indiana Program extends to all hospitals in the state.
- Adherence to the Program's rates is essentially compulsory for Indiana hospitals.
- The Indiana Program sets prospective rates based on periodic review of the hospital's financial picture.
- The main statistic reviewed and agreed upon by the Indiana Program is the aggregate percentage increase in the hospital's rates, which is based upon the projected hospital budget.

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[4] Other results of these studies are described later in this report, including Dowling's findings about hospital financial status.

[5] In addition to the New York studies, Heaton et al. (1976) and Thornberry and Zimmerman (1976) have analyzed the influence of statewide prospective rate setting programs. Their respective subjects were the New Jersey and Rhode Island systems. They found that these programs did not have a significant impact on hospital costs. However, these results were not unexpected since both programs were still in their early stages during the study years.

Skinner et al. (1975) examined the effects of the experimental prospective reimbursement system instituted by Blue Cross of Western Pennsylvania. However, the methodology and implications of this study were sharply constrained by the fact that only five hospitals were included in the experiment -- a rehabilitation center and four general hospitals situated in largely rural areas. Hellinger (1978) discusses the results of these three studies as well as Dowling's findings.

- The Program is addressed to the management of the hospital, repeatedly posing the question: Is this cost justifiable from the standpoint of efficient management?

- The Indiana Program conditions payment of capital expenses on planning agency approval.

- The Program is a private, nongovernmental system, administered by Indiana Blue Cross with the strong support of the Indiana Hospital Association.

- Sufficient manpower and other resources have been expended to support the Program's operation.

- The Program enjoys the solid backing of individual Indiana hospitals.

- The Program's establishment in 1960 makes it one of the oldest prospective rate setting programs in the country.

- While the Program has continually evolved since its inception, one of its distinguishing characteristics is strong continuity over time.

- The Program's setting is Indiana whose characteristics are not strikingly dissimilar from those of most other states.

The purpose of this study is to provide hard evidence about prospective rate setting and hospital cost control by performing a comprehensive evaluation of the Indiana Program.[6]

It is designed to achieve this goal in three ways. First, the study responds to the basic question of whether this country should rely on prospective rate setting to control hospital costs. It does so by conducting a definitive test of the general hypothesis implied in recent policy developments:

> Prospective rate setting can reduce hospital cost inflation without adversely affecting the effectiveness of hospital care and without incurring inordinate expenses.

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[6] Several earlier studies have addressed the Indiana Program, but none have comprehensively evaluated it. The most important are Bauer and Clark (1974) and Pauly and Drake (1970). These studies are described in later chapters.

Second, the Indiana Program represents a fundamental type of prospective rate setting. The study thus furnishes evidence indicating whether the Indiana-type approach to prospective rate setting is likely to succeed. Third, because of its broad scope the study illuminates important issues germane to the process of controlling hospital costs. Its findings therefore provide the basis for drawing conclusions generic to prospective rate setting and other forms of hospital cost control.

Within its overall purpose, this study has seven specific objectives. The first arises because prospective rate setting was created to control hospital costs, i.e., to reduce inflation in the price or average cost of hospital care (cost per case, or alternatively, cost per patient day). The prime test of the Indiana Program is therefore whether it can lower the rate of hospital cost inflation. Failure to impact hospital cost would constitute *prima facie* evidence that the Program is not successful. Accordingly, the first study objective is to determine if, and to what extent, the Indiana Program reduces hospital cost inflation.

The next issue is to identify the mechanisms through which the Indiana Program reduces cost (if such an effect is present). Does the Program's cost effect flow primarily through productivity, wage level, quality, and/or other variables? Identification of the variables transmitting the Program's cost impact is essential to the assessment of its net benefit. For example, if the Program lowers cost primarily by increasing productivity, that finding leads to sharply different conclusions than if it reduces cost mainly by decreasing quality. The second study objective is to determine the pathways of the Program's cost influence.

Even if the Program reduces cost in an appropriate way, it could still have undesirable side effects which would undercut the advantages gained through its impact on cost. Alternatively, it could have favorable side effects which would bolster its net benefit. For example, the Program could affect a variable like hospital net worth, which has little influence on cost but which is important in itself. Similarly, an impact by the Program on hospital quality or case mix would have important substantive implications even if the Program influenced cost primarily through other variables. The third study objective is to determine whether the Indiana Program has important side effects which enhance or reduce its net benefit.

Assuming that the Indiana system has significant effects on hospitals, the question becomes: How does the Program influence hospital behavior to produce these effects? What is its impact on key hospital decision makers? For example, does the Program exert its strongest influence on the administrator? If so, how does it change administrator behavior and thus hospital management? The fourth study objective is to determine how the Program influences hospital management to achieve its cost and other effects.

Like any regulatory program, the Indiana system has operating expenses. These costs offset to some degree the possible advantages gained by impacting hospitals. It is consequently necessary to include them in the assessment of the Program's net benefit. The fifth study objective is to determine the size of the Program's operating expenses.

The next step is to integrate the findings directed toward the first five objectives and to determine the Program's overall impact in Indiana. That is, based on the study findings, is the Program's net benefit in Indiana positive and substantial? Is it distinctly negative? Or, is it uncertain, e.g., is a cost decrease produced by the Program matched by a similarly produced quality decrease? The sixth study objective is to determine the net benefit of the Indiana Program.

If the Program's net benefit is positive, a critical question is whether the essential features of the Program can be replicated in other states. The seventh study objective is to assess the Program's replicability in other settings. Even if the system is a major success in Indiana, it may be difficult to establish similar programs in other states. Or, analysis may indicate that such a step would be relatively easy. If so, and assuming that the Program's net benefit is distinctly positive, the clear implication is that prospective rate setting programs similar to Indiana's could yield significant benefits in other states.

Organization of Study

A necessary antecedent to the project analyses is the descriptive characterization of the Indiana Program. That is, it is essential to identify the major characteristics of the program being evaluated. Similarly, it is necessary to delineate the characteristics of the control environments.

The analyses themselves were conducted in five segments, an approach taken for three reasons. First, while all study analyses are related in the sense that they are directed toward the Program's evaluation, the specific foci of some analyses are distinctly different. Second, data limitations necessitated the use of different hospital samples for certain analyses which are substantively related. Third, since this study is large and complex, segmentation of its analyses make its results easier to comprehend.

Sections IV through VIII are addressed sequentially to the findings of these five analysis segments. The section introductions as well as the chapters in these sections describe the primary characteristics of their respective segments. As a reference, Table 1-1 summarizes these characteristics.

Table 1-1

CHARACTERISTICS OF THE ANALYSIS SEGMENTS

Primary Purpose	Study Objectives Addressed	Time Period	Sample Size	Data Sources	Method of Analysis
Segment I: Determine the Program's impact on cost, productivity, and resource usage	(1) & (2)	'68-73 and '58-76	All study hospitals	Medicare Cost Reports, AHA Survey, and Census data	Regression Analysis and Time Trend Analysis
Segment II: Determine the Program's influence on labor usage, capital usage, and financial position	(2) & (3)	'68-73	60% of Main Study sample	Project Survey and Segment I sources	Regression Analysis
Segment III: Determine the Program's influence on case intensity, quality, and service mix	(2) & (3)	'70-73	40% of Main Study sample	CPHA data base and Segment I sources	Regression Analysis
Segment IV: Determine the Program's effect on hospital management	(4)	later study years	20% and 60% of Main Study sample	Site visits and Project Survey	Site visit analysis; Correlation analysis
Segment V: Determine the Program's operational expenses	(5)	FY 75	Inapplicable	Blue Cross and other data	Functional cost estimation

II.

Nature of Indiana and Control State Programs

An indispensable component of this study is a systematic description of the Indiana Program. Since the study determines the Program's effects by comparing Indiana and control hospitals, it is also necessary to define the nature of the control environments. The function of this section is to carry out these important tasks, with Chapter 2 addressing the first task and Chapter 3 the second.

The overall intent of Chapter 2 is to describe the Indiana Program as an operational system. The chapter therefore devotes careful attention to depicting both the structure and dynamics of the Program. In addition, it concisely describes the Program's history.

Chapter 3 begins at a theoretical level discussing the general principles which guided the selection of the study control environments. It becomes progressively more specific, describing the selection of the control states and then discussing the salient characteristics of those states.

2.
The Indiana Program

This chapter discusses the subject which is the focus of this report -- the Indiana Prospective Rate Setting Program. It provides an in-depth description of the Indiana Program as an operational system.

The first subject addressed is the structure of the Indiana Program. The next two chapter topics -- the mechanics of the rate review process and the nature of review -- are related yet distinctly different. The chapter then considers the characteristics of the Rate Review Committee -- a key component of the Indiana Program. It closes with a concise description of the Program's evolution over time.

A number of information sources were drawn upon to characterize the Indiana Program. The most important were on-site and telephone interviews with an array of individuals, including Indiana Blue Cross executives, Indiana Hospital Association staff members, hospital managers, past and current Rate Review Committee members, Rate Review Staff members, and government officials. Reports and informal documents were reviewed, with the Indiana Rate Review Manual (1977, 1971, and 1962) being especially valuable. The study by Bauer and Clark (1974) which describes the Indiana Program served both as a valuable starting point and as a useful source of specific information.[1]

In addition, selected responses to the Project Survey (discussed in Chapter 7) are employed in this chapter. These findings are based on the subsample used in Chapter 23. As indicated in that chapter, its characteristics are highly similar to those of the Segment I sample and the Indiana hospital universe.

Structure of Program

The Indiana Program was established in 1960 by Blue Cross/Blue Shield of Indiana (IBC) and the Indiana Hospital Association (IHA). Since its inception its primary purpose has been to control hospital cost inflation by increasing the efficiency of hospital care. The Program's managers have interpreted this purpose broadly. As stated in the Indiana Rate Review Manual (1977), the Program emphasizes not only

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[1] An earlier and more informal study by Lutts (1970) described the Indiana Program; in the same year Jones, TeKolste, and Webster (1970) discussed the salient features of the Program. Both studies were also utilized as information sources.

cost reduction, but also the provision of high quality care and the recognition of "community obligations to replace existing facilities, to continue education and research, and to keep pace with innovations in the health care field."

Prior to the Program's inception Indiana Blue Cross paid participating hospitals on the basis of billed charges, but did not review such charges in advance. Since 1960 participation in the Indiana Program has been a requirement of hospitals' Blue Cross contracts. IBC is the only Blue Cross plan in Indiana; it is the largest third-party payer in the state. Forty percent of Indiana's residents are insured by IBC.[2]

The prospective rates established by the Indiana Program apply directly to Blue Cross patients. In accord with Program guidelines, hospitals charge the same rates to self-paying patients and to individuals covered by commercial insurers. In a few instances hospitals have deviated from the guidelines by charging the rates set by the Rate Review Committee to Blue Cross patients and higher rates to other private patients. The Indiana Program strongly discourages such action, even though it gives IBC a competitive advantage. Presently, no hospitals operating under the Indiana Program use two-tiered rates.

Medicare and Medicaid do not reimburse hospitals according to prospectively determined rates in Indiana. These programs utilize their customary retrospective reimbursement approach. Thus, the Program's jurisdiction does not extend to Medicare and Medicaid beneficiaries.

Since the Indiana Program encompasses all but publicly insured hospital patients in the state, its scope extends to approximately 75% of Indiana hospital patients, which account for more than 60% of the state's hospital expenditures. Further, the Medicare program uses the Indiana Program's rates to calculate the ratio of Medicare charges to all charges, which is then applied to hospital costs to calculate Medicare reimbursement. It is therefore impossible for a hospital to avoid the Program's rates by transferring expenses to the Medicare program. Since the same points apply to the Medicaid program, the Indiana Program's rates constitute binding constraints. That is, Indiana hospitals cannot elude them by shifting costs among payers.

Indiana Blue Cross administers the Indiana Program. In 1960 a body called the "Special Committee on Hospital Rate Increases" (later named the Rate Review Committee) was formed by Blue Cross and charged with prospectively reviewing and approving hospital budgets and charges. The Rate Review Committee (RRC) now has 20 members (the maximum allowed under current Program guidelines). Six members are hospital managers,

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[2] Together the four largest commercial insurers in Indiana have a statewide penetration rate of approximately 20%.

termed the provider members. The remaining 14 RRC members, termed the public members, are drawn from a variety of backgrounds and professions.

Public members have always constituted a majority of the Committee, although the current majority of 70% is greater than has generally been the case.[3] All Committee members serve on a part-time basis with open-ended terms. The Rate Review Committee generally meets once per month. Indiana Blue Cross pays RRC members a small stipend and expenses for participation in the meetings.

Staff support for the Indiana Program is provided by Indiana Blue Cross. Although the resources of several Blue Cross departments are utilized, the primary group providing this support is the Rate Review Staff (RRS),[4] whose eight members are full-time IBC employees. RRS expertise is concentrated in the accounting area. Curtis O'Brien, the staff director, holds a Public Accounting Certificate. Prior to joining Blue Cross, Mr. O'Brien worked for 11 years as an auditor for the state of Indiana. His special area of concentration during his later years as a state employee was county and state hospital auditing. Three Rate Review Staff members are certified public accountants (CPAs); two others are degreed/experienced accountants. Staff support is provided by two rate clerks and secretarial staff.

The RRS is responsible for general coordination of the Indiana Program. It maintains on a day-to-day basis the relationship between the Program and the hospitals. This liaison function of the RRS has always been an important Program characteristic which spans the Staff's specific duties. During the early Program years, Blue Cross field staff often site visited hospitals to help them prepare their cost information. Such visits were infrequent during the mid-1960 to mid-1970 period, but the liaison function continued via telephone and written communication.

The RRS recently resumed the practice of site visiting hospitals, but the focus of these meetings is different from those in the early Program years. These visits are designed to give the RRS (and the hospital) the opportunity to discuss specific questions about the rate request and/or to clarify certain data items in the request. The visits are conducted after the rate request information has been submitted but prior to the RRC's review. Thus, the current site visits not only resolve specific problem areas prior to the actual review,

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[3] Public members composed 57% of the Committee's membership in 1960, 63% in 1968, and 56% in 1973.

[4] The Rate Review Department is currently based in IBC's Budget and Management Division. Until July 1974, this department was contained within IBC's Provider Relations Division.

they also give the Staff an opportunity to build a stronger overall relationship with the hospital.

The specific functions of the Rate Review Staff include:

- Screening the rate request, conducting a desk audit of the data presented, and evaluating the request for conformity with the Program's guidelines;
- Clarifying hospital data if necessary and counseling hospitals about what the RRC is likely to accept;
- Preparing and presenting a concise summary of each rate case to the RRC; and
- Monitoring hospital compliance with general Program guidelines and specific RRC directives.

While the Rate Review Staff is a central element in the Indiana Program, it does not have rate approval authority except in those instances when the rate modifications will have an inconsequential net effect. In all other cases, it is the Rate Review Committee's task to reach approval/disapproval decisions -- a responsibility actively exercised by the RRC. While the Committee carefully considers RRS recommendations, it does not simply ratify decisions made in reality by the Rate Review Staff.

An important element of the Indiana Program is the involvement of health planning agencies. In the Program's early years, review of hospital capital expenditures was loosely tied to planning principles. In 1962 IHA developed the Principles of Planning. In 1965 prior planning agency approval[5] of capital projects became an Indiana Program requirement in order for a hospital to include within its rate structure depreciation, interest, and other capital expenses arising from such projects.

Primary review of capital expenditures is currently undertaken by the three Indiana health systems agencies (HSAs), with final approval authority residing in the state 1122 agency, which was created under the federal program specified in Public Law 92-603. If a conflict arises between an HSA and the 1122 agency in regard to a specific project, the Indiana Program accepts the decision of the latter agency.[6]

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[5] During the middle sixties this review function was undertaken by voluntary planning organizations, whose development was fostered by IHA. They were forerunners of the federally-funded 314(b) area-wide comprehensive health planning agencies.

[6] Partially because of the Program's involvement in hospital planning, Indiana has not yet enacted a certificate of need law.

The Indiana Hospital Association is a strong state hospital association which has a close working relationship with IBC. It has been involved in the development and operation of the Indiana Program since 1960. Both the executive officer and chairman of IHA serve as ex officio members of the Rate Review Committee.

IHA's Council on Finance and Reimbursement plays a major role in devising the Program's guidelines and data requirements. In 1962 IHA developed the Principles of Pricing which, in addition to the Principles of Planning, formed the substantive base for the Program during its early years. The former document is still used by hospitals as a general guide in preparing rate requests and by the RRC in evaluating requests. The recent revision of the Indiana Rate Review Manual was a joint effort of IHA and IBC.[7]

Equally significant, the Indiana Program is solidly backed by individual hospitals. Eighty-four percent of Indiana hospital administrators responding to the Project Survey indicated that the Indiana Program is a good system and should be continued in its present form. Ten percent thought it should be replaced with another type of prospective rate setting program, while only 4% preferred a retrospective reimbursement system. An Indiana hospital administrator reflects the views of his colleagues when he says:

> The rate review people always treat the hospital with respect. The Committee takes a fair approach and does not make quick decisions. Although the rate review process is time-consuming for our hospital, we feel that it is worth it because the process allows us and other Indiana hospitals to be in it together.

The Indiana Program has been described as a voluntary effort. In fact, such a characterization is incorrect. At a minimum a hospital cannot opt in and out of the Program at will. That is, it cannot elect to come under the Program in favorable years, but remain outside the Program in unfavorable ones. Conceivably a dissatisfied hospital could defy the Indiana Program, reject its Blue Cross contract, and operate as a Blue Cross nonparticipating hospital. However, if a hospital took such a course of action, it would incur serious financial penalties. Partially for this reason and partially because of the Program's widespread support in Indiana, no hospital has ever challenged the Indiana Program in this way. However, since the Program's inception

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[7] Bauer and Clark (1974) emphasize both the "non-adversary relationship" between IHA and IBC, and the former's centrality in the Indiana Program. As they express it, "A strong association, it [IHA] has always been the moving spirit behind the controlled charges system."

in 1960, several Indiana hospitals have been constructed without prior planning agency approval, although such approval was eventually secured. In each case Indiana Blue Cross imposed a significant financial penalty until planning agency approval was obtained.

Participation in the Indiana Program is thus in effect compulsory for all Indiana hospitals. However, the Program is a system established and operated by the private sector. The extent of government involvement is minimal. Medicare has made a point of not participating in the Indiana Program. As discussed in a later section, it contends that its reimbursement principles are violated by the Indiana Program. Further, although studies (including this one) examining the Indiana Program have been supported by the federal government, no federal funds have been used to assist the Program's development.

While Medicaid patients are also not covered by the Indiana Program, informal liaison has been maintained for many years with the state government. Recently this relationship was solidified with the appointment of an RRC member representing the Governor's office. Similarly, each Indiana HSA now appoints, with IBC concurrence, one of its consumer representatives to the Rate Review Committee. However, despite these recent developments, the Indiana Program remains a predominantly private system -- a characteristic emphasized and valued by Indiana hospitals, IBC, IHA, and RRC members.

Mechanics of Review

Like all prospective rate setting systems, the Indiana Program attempts to control hospital cost inflation by restraining the growth of hospital revenues. Unlike some systems, the unit of payment used by the Indiana Program to accomplish this objective is approved charges for specific services, with the room rate being the most important single charge. That is, hospitals are paid charges, not costs, by IBC, commercial insurers, and private patients. For this reason the Indiana Program is often described as a "controlled charges" system -- a characterization which is partially deceiving. While the Indiana Program reviews many individual statistics and charges, its attention centers on the aggregate percentage increase in hospital rates, which is calculated directly from the projected hospital budget.[8]

The determination of individual charges is a complicated but relatively mechanical process. Charges for specific services are established based upon expected total hospital revenues, anticipated total hospital costs, and estimated utilization levels for different services. A constraint applied in this process is that in each hospital cost center,

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[8] This Program characteristic has not always been fully recognized by hospital analysts, although Dowling (1974) points it out.

the variance between revenue and cost cannot exceed 25% except in unusual instances justified by special factors. With input from the RRS as needed, the hospital includes a schedule of requested charges as part of its rate case submission. If the RRC's decision necessitates changes in the requested charges, such changes are made by the hospital with the concurrence of the RRS.

The main subject addressed by the Indiana Program is thus the total budget and its expected increase. While individual charges are carefully calculated, the Rate Review Committee does not spend appreciable time discussing them. Instead, the RRC and RRS begin with the total financial picture of the hospital and then examine specific hospital areas as appropriate. In this way the Indiana Program avoids the pitfall of becoming prematurely immersed in the details of hospital activities.

Under the terms of its agreement with Blue Cross, a hospital must give IBC at least 90 days advance notice of its intent to raise charges. Once notice is given, uniform financial and statistical data must be submitted to the RRS at least 45 days prior to an RRC meeting.[9] If data is submitted within this time frame, the RRC's decision becomes effective 90 days from the date the hospital provided notification to IBC. If data is not submitted at least 45 days prior to a Committee meeting, the effective date of the RRC's action is 90 days from the notification date, 45 days from the receipt of the data, or the next Committee meeting date, whichever is later.

The detailed supporting data required by the Indiana Program as part of a hospital's formal request for rate review is extensive.[10] Even so, based upon both the Project Survey and the Indiana site visits (described in Chapter 22), hospitals do not consider the Program's data requirements excessive.

The following required documents constitute the formal rate request submission.[11]

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[9] The Committee's monthly meeting schedule is published one year in advance, allowing hospitals to appropriately time their case submissions.

[10] IBC has developed hospital files containing data back to 1960. Computerization of rate request data began in 1975, working forward from 1973. The intent is for each hospital record to contain 10 years of data plus the budgeted year's information. The system is partially operational and currently generates summary reports.

[11] Data for all items must be submitted for the hospital's current fiscal year and budgeted fiscal year. In addition, data for items (1) through (4) must be completed for the year preceding the current fiscal year.

(1) A statement of revenues, expenses, and changes in working capital.

(2) Detailed hospital statistics, including beds, admissions, outpatient utilization data, occupancy data for each service area, length of stay, adjusted patient days,[12] and personnel statistics (including paid manhours, full-time equivalent staff [FTEs], manhours/inpatient day, and manhours/adjusted patient day).

(3) Comparative balance sheets for consolidated restricted and unrestricted funds. In addition to working capital and fund balances, this schedule requires that the hospital calculate selected statistics, such as the current ratio (current assets/current liabilities), the quick ratio (cash and investments/current liabilities), and days of operating cash (cash and nonrestricted investments at the end of the reporting period/the most recent month's operating expenses [excluding non-cash items]).

(4) A statement of changes in fund balances.

(5) A departmental summary of rate changes. For each department in which a rate for one or more services is being changed during the budgeted fiscal year, the hospital must detail the rate being changed and its billing unit (e.g., visits for the emergency room), the total projected units of service for the full budgeted fiscal year, the current rate, the requested rate, the increase or decrease for each service, and the annualized increase or decrease.

(6) An analysis of revenues and expenses by department.

(7) A salary and wage schedule for 13 "benchmark positions."[13] This schedule requires that the hospital calculate by benchmark category (for the current and budgeted fiscal years) the beginning, maximum, and average wage rates, as well as the average number of FTEs in each category. For the budgeted

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[12] The calculation of adjusted patient days is designed to take into account both outpatient and newborn nursery involvement. Specifically, adjusted patient days equals inpatient and outpatient revenue divided by inpatient revenue, multiplied by the sum of adult/pediatric days and one-half newborn nursery days.

[13] The benchmark positions are: general duty nurse, licensed practical nurse, nurses' aide, x-ray technician, medical technician, cook, food service helper, admitting clerk, medical stenographer, clerk typist, housekeeping maid, general maintenance worker, and laundry worker.

fiscal year the hospital must calculate the average hourly salary of all personnel, fringe benefits per hour, the percentage of fringe benefits to total payroll, and the total compensation per hour. The schedule also requests the hospital's current policy regarding general wage increases and merit increases.

(8) A departmental variance analysis which identifies departmental revenue changes due to volume, carryover, price, and new services. The departmental revenues reported in this schedule must correspond with those reported in (6) above.

(9) An expense analysis by natural classification, i.e., by accounting category. Examples of such categories are salaries and wages, drugs, and utilities. This schedule shows, for each category, the expected increase in expenses, and the extent to which this increase is attributable to volume changes and/or to price changes.

If significant capital expansion (requiring planning agency approval) is proposed by the hospital for the budgeted fiscal year, detailed capital expenditures schedules must be submitted in addition to the above information. A long range capital expenditure plan must be filed by all hospitals projecting expansion, renovation, or major capital purchases during the three-year period following the budgeted year, regardless of planning agency approval status.

The rate request application contains one final schedule, termed "Applicant's Notes." The hospital can use this schedule to explain any information on its accompanying forms. At a minimum, the Indiana Program instructs hospitals to address the following issues.

- Circumstances prompting the rate increase request.
- Methodology and assumptions used in the budgeted fiscal year projections.
- Specification of leased departments and purchased services.
- Explanation of increase or decrease in beds.
- Explanation of changes in FTEs if the hospital's manhours/adjusted patient day ratio increases.
- Pricing methodology for drugs and supplies.
- Disclosure of professional compensation and contractual arrangements.

According to the Blue Cross participating hospital agreement, all hospitals are required to submit an annual report to IBC within 90 days of the end of their reporting year. This report gives the Rate Review Staff the opportunity to review actual data for the hospital's last fiscal year and to compare it with the actual and projected data for that year shown previously on the rate request forms.

Using the data the hospital has submitted in its rate request application, the RRS prepares and then presents a decision-oriented summary of each rate case to the Committee. By concentrating on important features of the case and earmarking potential problems, the summary serves to focus the Committee's attention on important substantive issues.

The Rate Review Committee considers all hospital rate requests (except those which have an inappreciable net effect). It must reach one of the following five decisions on each request:

- Complete approval: The entire request is granted.
- Conditional approval: The request is granted but subject to periodic evaluations by the Program.
- Partial approval: Part of the request is granted.
- Deferral: The request is delayed pending receipt of further information.
- Rejection: The request is denied.

The Committee thus has a sufficient range of alternative actions to permit it to function effectively. All of these actions are prospective. There is no provision for retroactive adjustment in the Indiana Program.

The percentage of hospital requests rejected by the RRC is about 5% -- a rate which has remained relatively constant during the last decade. In contrast, there has been a sharp increase in conditional approvals and a corresponding decrease in partial approvals. Excluding deferrals, 32% of rate requests were partially approved and 5% were conditionally approved in 1969; the corresponding statistics in 1977 were 7% and 40%.

In the past an Indiana hospital could request a rate increase as often as it deemed necessary. In actuality most hospitals sought rate changes approximately once a year. This practice is now a formal Program requirement. Once a year, but not more often, a hospital may routinely request a rate increase, termed the annual request. In most instances this request becomes effective at the beginning of the

hospital's fiscal year, but this is not mandatory.[14] During the year hospitals may make additional requests, termed emergency requests. However, to have such a request granted a hospital must demonstrate not only that the increase is generally warranted, but that it is necessary on an emergent basis.

Illustrating this point, the Rate Review Committee recently denied a hospital's emergency request which was based on a sharp rise in its malpractice insurance premiums. The Committee contended that while malpractice premiums are a legitimate hospital expense, the hospital had not sufficiently demonstrated why it had not anticipated the premium increase, especially given the publicity this issue receives in the public press.

In examining an emergency request the Committee considers the net changes in total budgeted expenses and revenues, and the demonstrated efforts by the hospital to manage the increase within alternatives already available, e.g., the level of cash on hand or the use of short-term loans. In an emergency request, the burden of proof always rests with the hospital. As it did with the hospital requesting review because of increased malpractice insurance rates, the RRC will reject emergency requests which it feels arise because of poor planning by the hospital. However, in instances where a new administrator has found the hospital's charges significantly out of line and/or the hospital in a precarious financial position, the Committee has granted emergency requests.

The Indiana Program emphasizes individual hospital evaluation. Although large rate requests are scrutinized more rigorously than small ones, the Program does not apply a single screen or a series of screens to rate requests. For example, it does not employ a 7% screen which grants automatic approval without rate review to hospitals requesting increases below this figure.

Individual RRC members compare Indiana hospitals in terms of wage rates and other statistics. The Rate Review Staff constructs simple peer group comparisons, with the groups based on hospital size or location. However, the Program does not utilize sophisticated comparisons which

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[14] Since approximately 75% of Indiana hospitals use the calendar year as their fiscal year, many rate reviews are scheduled during November and December. A review of the RRC's monthly caseload distribution for the most recent three-year period reveals that about one third of the requests were presented to the Committee in those two months. If at any time the Committee cannot review all scheduled requests during its normal one-day monthly meeting, it convenes for a second meeting to accomodate all requests.

group hospitals based on their values for important cost determinants. Similarly, it does not use formulas to calculate either hospital rates or hospital cost comparison standards.

The Indiana Program employs written guidelines which are an important component of the Indiana Rate Review Manual. These guidelines are general rules designed to be interpreted flexibly. They are not intended to be detailed strictures. The Indiana system places a premium on the individual judgment of RRC/RRS members. Its contention is that if the rules are too detailed, hospitals can beat the system since they can turn the rules to their advantage. Instead, if general guidelines are carefully applied to specific cases by the RRC/RRS, hospitals will be forced "to comply not only with the letter of the Program but also with its spirit." Further, as one hospital administrator says: "A strict standard originally imposed as a ceiling may eventually become a floor."

The dominant atmosphere of RRC meetings is informality. The meetings are closed to the public, although observers may attend with prior permission. At each session the Committee first considers cases deferred from previous meetings. New requests are then considered, with more difficult and/or time-consuming cases being examined prior to more routine requests.

At times criticism has been directed toward the Indiana Program for not distributing case materials to the Committee members prior to the meeting. Although such a step would enable RRC members to more fully consider individual cases, the Program has not adopted this approach for two reasons. One is to protect confidentiality -- an action felt to be important in fostering continued hospital support of the Program. Consistent with this point, RRC members do not retain case materials at the close of a meeting.

The other reason is the constraint imposed by time. Given that hospitals do not submit detailed information until 45 days prior to the RRC meeting, it would be difficult for the RRS to complete the analysis of each hospital's rate case in sufficient time to comfortably distribute case materials to Committee members in advance of the meeting. However, the Program is aware that this is a problem area. As an intermediate step it recently began distributing synopses of the rate cases to RRC members approximately one week prior to the meeting.

Consideration of each rate request begins with a summary presentation by the Rate Review Staff. The practice of not distributing case materials in advance puts a premium on the RRS' ability to accurately and succinctly characterize each rate request. Committee and Staff members then discuss the case among themselves, with the former taking the lead role. No time limit is imposed on the consideration of individual cases.

Hospital representatives are not present during the RRC meeting unless they are asked by the Committee to join the session to respond to specific questions. They do have the right to appear before the Committee if action other than full approval is contemplated. After discussion of the case, the RRC reaches by majority vote one of the five decisions described earlier. At the time of the meeting the hospital is informally told of the RRC's decision, with official notification sent at a later date.

If a hospital's rate case presents a conflict of interest for an RRC member, that member does not remain in attendance during the Committee's consideration of the case. For example, a provider member leaves the room during the Committee's review of not only his/her hospital's rate case, but also the rate cases of neighboring hospitals.

Since a deferral decision often means the rate increase will be delayed, the RRC limits such decisions to those requests which it feels cannot be objectively reviewed without additional information. For two reasons, the frequency of deferrals has consistently declined, from 16% in 1969 to 3% in 1977. First, the Program has progressively improved its specification of information requirements and its pre-review clarification of questionable areas. Second, hospitals have become more skilled in preparing their rate request packets (in some cases with substantial RRS assistance).

If the Committee accepts the rate request as submitted, the increase becomes effective 90 days from the date the hospital provided notification to IBC. In the case of a conditional approval, the increase becomes effective at the same time as if it were a full approval. However, in such instances the RRS periodically monitors (usually quarterly, but sometimes monthly) those items identified as problem areas by the RRC. As part of this responsibility, the RRS reports significant deviations to the Committee.

If the Committee has rejected or only partially approved a rate request, the hospital is advised to contact the RRS for clarification. A hospital can, of course, simply accept the Committee's decision at this point. If it does not, an informal conference is held between the Staff and the hospital to discuss alternatives to a formal appeal. The RRS offers its assistance in preparing a revised case for the Committee if the hospital wishes to re-submit.

Following this conference, the RRS notifies the Committee of whether a compromise was effected or an appeal is forthcoming. The hospital may re-present its case at either of the next two regularly scheduled Committee meetings following the original decision. If the Committee and the hospital still cannot reach agreement, appeal procedures are instituted, with the Executive Committee of the Blue Cross Board serving as the appeal body.

Formal appeals to the Blue Cross Executive Committee are extremely rare under the Indiana Program. Shortly after the appeal process was instituted in the mid-1960s, appeals were somewhat more common. Partially because most appeals were denied, hospitals do not presently rely on this mechanism. Further, as Bauer and Clark (1974) state:

> For the most part hospitals accept RRC's recommendations with good grace. They can, after all, submit a new application that will take the RRC's objections into consideration. During the period 1960-73, no hospitals took court action to overturn Blue Cross rate decisions. Although hospitals have threatened to withdraw from their Blue Cross contracts on two or three occasions, they have never done so.

RRC meetings do not have the tone of a public hearing. Partially as a result, the Indiana Program has not been episodically diverted from its main purpose of hospital cost control. That is, it has not been forced to consider publicly sensitive issues perhaps important in themselves but highly peripheral to hospital cost control, such as poor emergency treatment of an individual by a hospital whose reputation is generally good.

Further, unlike some regulatory systems, the Indiana Program has not become enmeshed in legalistic process. Although hospitals must submit substantial amounts of data, they do not customarily prepare extensive statements describing their position. Briefs written in legal terms are rare. Except in unusual circumstances, a lawyer is not among the hospital representatives at an RRC session. IBC and IHA are not represented by counsel at these meetings. Only once has the RRC included a lawyer among its members.

Nature of Review

The Indiana system emphasizes cooperation rather than conflict with hospitals. Consistent with this approach, the Program recognizes the "total financial needs" of hospitals as community institutions. For example, the Program assumes an encouraging posture on hospital involvement in the education of nurses and other health professionals. It accepts both the patient care costs of education programs and their teaching and administrative costs (net of grants, tuition, donations, etc.). However, the Program does not grant hospitals a blank check to engage in all types of community activities. As an illustration, hospitals offering community mental health services must seek separate sources of funds rather than subsidize such services through other types of patient revenue.

Another example of the total financial need policy is the limited term rate, which is designed "to cover operating and capital needs in excess of available resources." The specific objectives of these rates include generating funds for "extraordinary expense items, capital applications in excess of capital resources, and reasonable working capital increases."

Limited term rates have provided important assistance to individual hospitals. However, the Rate Review Committee is often reluctant to grant such rates. If they are approved, a number of general conditions are attached. First, the limited term rate is effective from the date of the increase to the end of the budgeted year. At the end of that period, the rate is automatically withdrawn and justification for its continuance must follow the normal procedure for rate increase approval. Second, any funds derived from a limited term rate must be separately accounted for by the hospital. Third, the funds derived from a limited term rate must be used for the specific purpose for which the rate was sought or for an alternate program approved in advance by the RRC and the planning agency (if necessary).

In addition to these general conditions, the RRC may impose specific stipulations on a limited term rate. For example, it might approve a limited term rate subject to the provision that the hospital must obtain alternative financing by the time of the next rate request. If the hospital violates any provisions attached to a limited term rate, the Committee will set future rates in such a way that the limited term funds are extracted from the hospital.

As part of its total financial need policy, the Indiana Program considers the hospital's working capital position in establishing prospective rates. A hospital's working capital position reflects its past gains and losses. Consequently, a hospital's rates in the upcoming fiscal year (FY B) will increase less if it is relatively efficient and does better than expected during the current fiscal year (FY A). The reason is that the hospital's working capital position will be better at the end of FY A than had been anticipated at the beginning of that year. A hospital is thus unable to consistently earn large profits under the Indiana Program.

Conversely, if a hospital's performance is less favorable than expected in FY A, it can regain some of its losses during FY B. Again, the rationale is that the hospital's working capital will be lower at the beginning of FY B than had been anticipated at the beginning of FY A. The Program will permit this hospital to increase its rates during FY B in order to improve its weakened working capital position. However, if the Program thinks that managerial inefficiency is the cause of this hospital's unfavorable financial performance, it may force the hospital to make changes during FY B. For example, it may grant the hospital only a conditional approval, or it may defer or even reject this hospital's rate request until certain managerial improvements have been instituted.

Another hallmark of the Program is balanced review of the hospital. That is, the Program considers all aspects of hospital operations. Even so, both the RRC and RRS concentrate to some extent on hospital utilization of labor resources. The Program carefully reviews hospital wage rates, focusing on the benchmark positions. It gives equal attention to hospital staffing patterns and the mix of personnel types utilized by the hospital. It scrutinizes both the total number of full-time equivalent employees and FTEs in each benchmark position. In addition, the Program considers FTEs employed in different hospital departments, reviewing the ratios of manpower to output units. For example, in the radiology department it examines the ratio of FTEs to procedures.[15]

Hospital utilization of supplies and services is also carefully reviewed. As an example, the Program analyzes the extent to which cost increases in such categories as drugs, medical/surgical supplies, and contract services are due to volume changes or to price changes.

In the capital area the Program questions hospitals about alternative funding sources, and it insists that hospital depreciation and debt service practices comply with its guidelines. In theory, the Rate Review Committee could reject a capital project even if it were approved by the appropriate planning agency. In practice this has never happened. Conversely, the RRC will not approve capital expenses for projects which have been rejected by the designated planning agency. The Indiana Program has thus delegated to planning agencies most of its capital review functions. That is, the RRC/RRS has retained review of capital financing and accounting practices, but they do not in fact consider the larger issue of whether a capital project should be undertaken.

The Indiana Program is directed toward the administrative side of the hospital. With board approval, the administrative staff[16] prepares and defends the hospital's rate request. It is also responsible for monitoring hospital costs and for ensuring that such costs do not exceed the prospective budget approved earlier by the Rate Review Committee.

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[15] Bauer and Clark (1974) also stress the Program's emphasis on the labor component. They state: "The principal thrust of the RRC's efforts . . . has always been directed toward the payroll component, both as regards salary scales and ratios of hospital employees to occupied beds."

[16] As implied here, in this report the administrative staff is defined as the administrator, financial officer, department heads, and their immediate staffs.

In contrast, Indiana physicians are relatively distant from the Program. This point is evident in several ways. First, the great majority of practicing physicians do not share the financial incentives facing hospitals under the Indiana Program. As in other states, most Indiana physicians are office-based providers who use the hospital as independent practitioners. While pathologists, radiologists, and other physicians contracting with the hospital may be more directly influenced by the Program, it is rare even for these physicians to share with the administrative staff the responsibility of meeting the hospital budget.

Second, although a few physicians have served as RRC members, the great majority of Indiana physicians have had little direct contact with the Indiana Program.[17] Third, a representative of the Indiana Medical Association has never been an RRC member nor have there been other formal ties between this association and the Program. Similarly, although utilization review programs have recently been developed in Indiana, there has been little interaction between such programs and the rate review system.

Fourth, extensive information is required from Indiana hospitals about administrator-oriented variables such as costs, revenues, FTEs, and working capital. Data is not sought about such physician-oriented variables as case intensity or quality. Nor is data obtained about the hospital's service mix. While qualitative information about changes in output mix may be introduced by a hospital or by individual RRC members, such changes are not explicitly documented by the Program as are, for example, changes in staffing patterns.

The lack of emphasis on physicians is consistent with the Program's overall objective -- to encourage the efficient provision of hospital services. In general, the Program accepts the hospital's definition of what its output should be.[18] It then questions the hospital about whether it is providing that output efficiently. Accordingly, the

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[17] Each of the three physicians currently serving on the RRC has been associated with the Indiana Program for a substantial period of time, ranging from four to ten years. None of these physicians is an office-based practitioner. Over the past decade, physicians have generally comprised about 20% of the Committee's public membership and about 14% of its total membership.

[18] Through their review of proposed capital projects, Indiana planning agencies have influenced the hospital's definition of its appropriate output. However, their emphasis has been upon incremental hospital changes as opposed to radical redefinitions of basic hospital roles. In addition, like the RRC/RRS, planning agencies have not evaluated such important output variables as case intensity and quality.

Program's natural target is not the physician staff but the administrative staff, who has the responsibility for determining the number of inputs employed, the prices paid for the different inputs, and the production techniques used.

The central thrust of the Indiana Program is thus toward the management of the hospital. While accurate accounting is one of its necessary ingredients, the Indiana Program is not an accountant's program. Instead, it is a manager's program. It emphasizes whether a cost is justifiable, not whether it is allowable.

This distinction is crucial. Using the dietary department as an example, an allowable cost system relies on such restrictions as: Out-of-season vegetables and certain grades of meat may not be used or their costs will not be allowed. In contrast, a justifiable cost system explicitly or implicitly poses such questions as: Is the dietary personnel complement too high? Are dietary wage rates out of line with those of other hospitals? Could steps be taken to reduce food waste?

The Medicare program is the most prominent example of a system emphasizing allowable costs. Its philosophy of paying hospitals is fundamentally different from that of the Indiana Program. It is this difference which accounts for Medicare's refusal to participate in the Indiana Program.

The Medicare program accurately contends that the Indiana Program covers costs which are unallowable under Medicare regulations. For example, the Medicare program allows as costs only those bad debts related to Medicare patients. The Indiana Program permits inclusion of all bad debts as a legitimate item in the calculation of the hospital's rates.[19] However, the Indiana Program, but not the Medicare program, reviews the size of the hospital's bad debts. If it feels that they are too high, it questions the hospital about collection and related practices.

As another illustration, the Indiana Program permits inclusion of the net costs of approved nursing education programs. This applies whether the educational program is conducted solely by the hospital or if a portion of the training is provided by an outside institution with

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[19] Because the Indiana Medicaid program covers only the categorically needy, the consequences of this bad debt policy are greater in this state than they would be in many others. Both Indiana Blue Cross and commercial insurers (as well as self-paying patients) cover some hospital expenses of the medically needy, who are neither their beneficiaries nor Medicaid cases. Bauer and Clark (1974) point up this "Robin Hood aspect" of the Indiana Program.

which the hospital contracts for educational services. In contrast, the Medicare program allows only those nursing education costs which relate directly to hospital-provided training. It considers unallowable expenses for educational services rendered outside the hospital, even if contracting for such services produces a substantial saving for the hospital.

Medicare thus argues that its costs would be higher if it participated in the Indiana Program. The Indiana Program rejoins that Medicare costs are in fact much lower because of the Indiana Program and that by not participating Medicare is taking unfair advantage of both the Indiana Program and Indiana hospitals. This argument has raged for many years and remains unresolved. As a consequence, the Medicare and Indiana programs continue to operate at a distance.

The continuing dispute between these programs graphically illustrates the difference between systems which ask whether costs are justifiable, and systems which emphasize whether costs are allowable. This difference is one of the core issues addressed by this study.

Characteristics of the Rate Review Committee

The Rate Review Committee is a standing committee of the Blue Cross Board of Directors. Unlike the Board's other nine standing committees, the RRC has decision-making authority. Decisions reached by the RRC are ratified by the Board. Committee members are appointed by IBC's Board of Directors for open-ended terms, with average length of service estimated at five years. Tenure on the Committee ranges from more than ten years for the current Committee Chairman, Samuel Frumer, to approximately one year for the HSA consumer representatives and the Governor's representative.

The Committee's provider members customarily include two representatives each from county, Catholic, and other not-for-profit hospitals.[20] Current practice is for five of the six provider members to be hospital administrators and for the remaining member to be a financial officer. Provider members usually embody a range of hospital characteristics and are thus generally representative of Indiana hospitals.

Even so, representativeness is a less important selection criterion than is expected effectiveness. Both IHA and IBC carefully weigh the qualifications of hospital managers being considered for Committee

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[20] Forty-five percent of Indiana hospitals are county institutions, many of which are small hospitals located in rural areas. Slightly less than 15% are Catholic institutions, while about 35% are other not-for-profit hospitals. The remaining 4% are city, state, or for-profit hospitals.

membership. A specific (albeit informal) requirement is that prior to RRC appointment, a hospital manager must serve on IHA's Council on Finance and Reimbursement for at least two years. A more general criterion is that a hospital manager should have a good reputation as an efficient manager and a strong interest in meeting the goals of the Indiana Program.

As indicated earlier, public members have always constituted a majority of the Committee, accounting for 70% of the RRC's current membership. These public RRC members reflect many forces in Indiana. In addition to the HSA and Governor's representatives noted earlier, the public members include a commercial insurance executive, several industry managers, a nursing home executive, a union staff member, a bank officer, and a hospital-based physician. The Committee Chairman is an accounting professor at Indiana University.

Although the public members have been broadly representative of Indiana, few have been pure consumers. Most were expected to add to the Committee's expertise either because of knowledge about a specific aspect of the health care industry or because of experience generally germane to hospital operations. The former qualification is illustrated by the nursing home and commercial insurance executives and the latter by industry executives directly involved in finance and accounting.

Table 2-1 shows the composition of the Rate Review Committee during the last 11 years. Specifically, it indicates Committee membership at present, and in 1968 and 1973, the two end years of the main study period. As indicated, the 1968 Committee was composed of three provider and five public members. Its Chairman, Fred Lobley, was an industry executive.

In 1973 the Committee had increased to 16 members -- nine public and seven provider members. Samuel Frumer served as the 1973 Committee Chairman, although Mr. Lobley continued to participate as a member. Added skill areas evident among the 1973 members include nursing home and banking expertise. The current 20-member Committee operates under Mr. Frumer's chairmanship. Its 14 public members represent the wide-ranging skill areas discussed previously. Further, two of the HSA representatives are university instructors, and the other is a private businessman. The Governor's representative is a practicing CPA.

At least in the eyes of Indiana hospitals, the provider and public members together make a potent combination. The provider members bring the necessary component of thorough knowledge about hospital operations. The RRS also strongly contributes in this area, but it is important to have hospital expertise at both the committee and staff levels.

Table 2-1

COMPOSITION OF THE RATE REVIEW COMMITTEE

1968*	1973	1978
Public Members		
Fred A. Lobley (Committee Chairman) Vice-President Dow Chemical Elkhart	Fred A. Lobley	
Samuel G. Frumer Professor of Accounting Graduate School of Bsns. Indiana University Bloomington	Samuel G. Frumer (Committee Chairman)	Samuel G. Frumer (Committee Chairman)
Victor G. Rose Personnel Director Delco-Remy Anderson	Victor G. Rose	Robert Alerding Vice-Pres., Finance Insley Manufacturing Indianapolis
William J. Stangle, M.D. Radiologist Bloomington Hospital Bloomington	Lester H. Hoyt, M.D. Director of Laboratory Methodist Hospital Indianapolis	Lester H. Hoyt, M.D.
Dallas W. Sells Executive Director AFL-CIO Indianapolis	Max F. Wright Secretary-Treasurer AFL-CIO Greenwood	Max F. Wright
	Samuel Gunnerson Vice-President Turtle Creek Convalescent Centres Indianapolis	Samuel Gunnerson
	Charles Rushmore, M.D. Medical Director Indiana Bell Telephone Co. Indianapolis	Charles Rushmore, M.D.
	Thomas J. Hall Vice-President Metropolitan Division Indiana National Bank Indianapolis	Clayton Pruitt Vice-President and Trust Officer Indiana National Bank Indianapolis

* In 1968, each Rate Review Committee position had an alternate Committee member assigned to the position. Alternates are not specified on the table, but they could attend all Rate Review Committee meetings and could vote in the absence of the original designee. Four members of the 1973 Rate Review Committee (Dr. Hoyt, Mr. Wright, Mr. Lackey, and Sister Carlos) served as alternates on the 1968 Committee.

Table 2-1 (continued)

1968	1973	1978
	Ralph Lehman Vice-President and General Manager Ross Gear Division of TRW, Inc. Lafayette	Richard J. Sager Vice-President and Secretary-Treasurer Central Soya Fort Wayne John S. Pearson, M.D. Vice-President Medical & Underwriting American United Life Insurance Co. Indianapolis Rolf K. Klebe Director General Accounting Detroit Diesel, Allison Division Indianapolis John Gaither Cert. Public Accountant Gaither, Hortin & Koewler Evansville (Representative of the Governor's office) Harry G. Day Acting Chairman of Home Economics Indiana University Bloomington (HSA representative) Carlyn Johnson Associate Professor School of Public and Environmental Affairs Indiana University Bloomington (HSA representative) Charles J. Harman Businessman Logansport (HSA representative)
<u>Provider Members</u>		
Arthur S. Malasto Administrator Porter Memorial Hospital Valparaiso	Arthur S. Malasto	Peter Mariani Administrator Riverview Hospital Noblesville

Table 2-1 (continued)

1968	1973	1978
Robert D. Jacobs Administrator St. Joseph Hospital Kokomo	Sister M. Martin Administrator St. Joseph Hospital Kokomo	Sister M. Martin
Jack Hahn Administrator Methodist Hospital Indianapolis	Nolan R. Lackey President Welborn Memorial Baptist Hospital Evansville	Larry Mangold Assistant Administrator of Finance Methodist Hospital Gary
	David Kramer Administrator La Porte Hospital La Porte	David Kramer
	C.L. Morris Administrator Hancock County Memorial Hospital Greenfield	Robert S. Borczon Administrator Bartholomew County Hospital Columbus
	Sister Carlos McDonnell Administrator St. Vincent Hospital Indianapolis	Herman Kohlman Executive Director Jasper Memorial Hospital Jasper
	Ernest Baughman Administrator Morgan County Hospital Martinsville	

The public members add two essential elements. First, their presence alone changes the nature of the Committee. It is not solely a group of hospital managers well-known to each other, but rather a broader-based body reflecting a diversity of interests. The Committee meetings thus do not have a "club-like" atmosphere. Further, the public majority, in combination with other Program features, substantially reduces the possibility that the Program might be subject to antitrust scrutiny for restraint of trade -- an occurrence which has never arisen.

Second, the public members bring new perspectives and expertise. One example is an industry executive who carefully scrutinized hospital staffing patterns and at times asked hospital administrators: Why in the hospital industry do you feel you must hire all the people requested by your department heads? Another example is a physician who kept extensive records of wage rates in Indiana hospitals, and posed detailed questions in this area.

Two concerns are frequently expressed about industry involvement in a regulatory process -- partiality toward the industry and favoritism toward specific industry members. Neither concern has surfaced in Indiana. There is general consensus that if anything, the provider members are tougher than the public members. This characteristic may, however, be enhanced by the presence of the latter. Allegations have never been raised that provider members tend to reward their friends and penalize their enemies. Several long-time provider members confirm this point. They indicate that they have never been contacted prior to an RRC meeting by a hospital administrator requesting favorable treatment. One public RRC member summarizes these points:

> In my tenure on the Rate Review Committee I have not been aware of examples of favoritism by hospital members of the Committee. Also, I have seen no instances where they appeared to be feathering the nest of the hospital industry. In fact, they are generally harder-nosed than the nonhospital members.

The part-time nature of Committee membership is a Program characteristic with several significant advantages. First, because they are part-time, the RRC members have a more detached and perhaps more objective perspective. That is, a part-time member may feel freer than a full-time member to "call the shots as he or she sees them." Second, it is less expensive to use a large number of part-time RRC members than a small number of full-time members. Third, and most important, it would not be possible to attract the same breadth of knowledge and expertise if Committee assignments were full-time positions. Illustrating this point, it is likely that all present RRC members would find it necessary to resign if Committee positions were converted to full-time assignments.

The use of part-time RRC members also has significant risks. One is that Committee members may be insufficiently informed to be good reviewers. As indicated earlier, this has not occurred. In fact, the reverse is true: Committee review is considered to be tough and knowledgeable.[21] As one administrator says:

> If you don't do your job well, if you have holes in your planning and in your request, you'll be nailed by either the Staff or the Rate Review Committee.

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[21] However, Program participants point out that it often takes time to learn to function as an effective Committee member. Provider members are generally active participants in Committee deliberations from their first meeting, while the average introductory period for public members is three to six months.

Contributing to this result is the fact that at least two points of view are available to the Committee -- those of the RRS and the hospital. In contrast, the part-time board of a hospital or industrial corporation is often given only the views of the administrative staff.

Another risk is that part-time Committee members may be insufficiently interested. An excellent index of interest is attendance. The monthly attendance of RRC members averages between 85% and 90%. Hence, this potential drawback of the part-time model does not materialize in the Indiana Program.

History of Program

The Indiana Program was founded in 1960 primarily in response to growing concerns in Indiana about rising hospital costs. Several newspaper articles decrying hospital cost increases had been published. For the only time in its history, the state government held hearings about hospital cost inflation. Indiana hospitals became concerned about state or even federal intervention. As a consequence, prominent hospitals in the state encouraged IBC and IHA to set up a private cost control program that would pre-empt government action.

Since that time many Program characteristics have remained unchanged. As examples, the Indiana Program is still lodged in Blue Cross and the Rate Review Committee continues to be composed of part-time public and provider members. Further, the Indiana Hospital Association continues to play an important role in revising the Program's guidelines and data requirements.

However, the Program's techniques and operating style have steadily evolved as it has accumulated experience. One example is that the Program's information requirements are much more extensive now than they were in 1960 or even 1968. Another is expansion of the role of the RRS, which currently exercises a greater range of responsibilities than it did in the 1960s. Yet another is that the frequency of RRC meetings has changed. In the early Program years these meetings were informal and held on an as-needed basis. During the early 1970s, in response to the increasing sophistication of the rate review process, Committee meetings were scheduled on a monthly basis and began consuming an entire day.

Although the Program's primary focus has always been hospital cost control,[22] its objectives have gradually broadened with the passage of time. Initially the Program was wary about interfering in the internal management of the hospital. It now realizes and even stresses that many of its actions necessarily require internal management changes. However, the Program still prefers to leave resolution of identified problems (e.g., excessive nursing personnel) to the administrator.

Program participants report that as the Program gained expertise, it became more confident. As a consequence, it became more agressive, i.e., more willing to challenge hospitals on a broader range of issues. Partially as a result it became more competent and its stature among Indiana hospitals increased. It thus became more serious about controlling hospital costs and was taken more seriously by Indiana hospitals. These points are well enunciated by a long-time provider member of the Rate Review Committee:

> In the early years we were flying by the seat of our pants. We did not know what indicators to rely on, what questions to ask, etc. As a result, we were more restrained in our recommendations and tended to see ourselves in a narrower role. As we learned the techniques of cost control, both our objectives and our perception of our role broadened. At the same time we became more stringent since we became more confident about what we were doing.

A hospital administrator expressed his view of the Program's development in the following way:

> The Rate Review Committee guidelines have really been tightened, especially in the past five years. What is and is not okay is much more definitive now than it was years ago. It has been an evolving process with the rate review system becoming more and more sophisticated.

While the Indiana Program and the Medicare program have always operated at a distance, the institution of the latter in 1966 affected the former

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[22] As indicated by Bauer and Clark (1974), an early Program objective was to reduce inequities in charges paid to similar hospitals. Although stated euphemistically, this process amounts to questioning high charge hospitals about why their charges are higher than those of similar hospitals. That is, as is often appropriate for a prospective rate setting system, in its early years the Indiana Program concentrated on those hospitals considered to be most out of line in terms of charges and costs.

in several ways. First, it produced a distinct improvement in hospital financial and accounting techniques. The Medicare program required the completion of a uniform financial report by hospitals.

The Chart of Accounts for Hospitals was revised by the American Hospital Association (AHA) in 1966, largely in preparation for the implementation of the Medicare program. Several years later hospital accounting was further standardized with the publication of the Medicare Audit Guide and the Hospital Audit Guide by the American Institute of Certified Public Accountants. Reflecting these developments, many hospitals strengthened their financial departments; others began obtaining outside assistance from accounting experts. This resulting increase in hospital fiscal expertise facilitated the Indiana Program's efforts to make its rate review techniques more specific and sophisticated.

Second, establishment of the Medicare program sharply expanded the demand for hospital services, thereby fueling the high rate of hospital cost inflation that has prevailed since the mid-1960s. Since it is usually easier to reduce a 15% inflation rate than a 5% rate, Medicare's inflationary impetus provided a larger base of potential influence for the Indiana system.

Hence, despite the lack of coordination between these programs, Medicare actions had the unintended effect of enhancing the Indiana Program's effectiveness. The Program has also been impacted by another federal program -- the Economic Stabilization Program (ESP) -- which regulated hospitals on a nationwide basis from August 1971 through March 1974. In 1972 the Governor of Indiana designated the Rate Review Committee as the state advisory board for ESP. Consequently, during the ESP years the RRC was charged with a dual function: establishing hospital rates under the Indiana Program and monitoring hospital compliance with ESP regulations.

In accord with its ESP responsibilities, the Indiana Program required hospitals to include copies of their ESP S-52 forms as part of their rate request submissions. This step significantly increased the information available to the Program. Further, like the Medicare program, but to a lesser extent, ESP had a positive impact on hospital accounting practices. This effect was most prominent in smaller hospitals which often found it necessary to use outside accounting assistance to comply with ESP regulations. Thus, both the quantity and accuracy of data submitted to the Indiana Program rose during the ESP years. Since then, these improvements have been retained and expanded upon, as is evident from the Program's current data requirements.

On the whole, the Indiana Program continued to operate in its usual manner during the ESP years, although certain Program guidelines were not followed as closely. For example, when a few hospitals experienced financial difficulties because of ESP restraints, the Program allowed them a wider working capital margin than had been its customary

practice. Nonetheless, during the ESP years the Indiana Program continued to scrutinize hospital use of supplies, services, and especially labor; and the RRC/RRS and planning agencies continued to review hospital capital utilization in their respective areas of responsibility. The ESP years thus did not witness significant changes in the mainline functions of the Indiana Program.

Despite the coordination between ESP and the Indiana Program, the former was resented by Indiana hospitals as it was by hospitals elsewhere. Some of this resentment may have carried over to the Indiana Program. However, this effect was more than offset by another. The Economic Stabilization Program made it manifestly clear that hospital cost containment was a serious matter. The imposition of ESP controls on hospitals and their delayed removal (compared to most industries) alarmed hospitals, and strengthened their determination to develop effective cost control programs which would pre-empt federal regulation. This process occurred to some extent throughout the country. Its specific result in Indiana was to further solidify hospital support of the Indiana Program.

Many of the individuals central to the Indiana Program have been involved for many years. Elton TeKolste, executive officer of the Indiana Hospital Association, has been deeply involved in the Indiana system since 1960. He serves as an ex officio member of the Committee. Robert Jones, a senior vice president in IBC's Health, Education, and Technical Services Division, was instrumental in the creation of the Program and continues to play a significant role. Curtis O'Brien has directed the Rate Review Staff for almost seven years. Samuel Frumer, present RRC Chairman, has been a Committee member since 1965. Other RRC members have also served for long periods of time. For example, two original Committee members -- Arthur Malasto, a hospital administrator, and Fred Lobley, a public member and the original Chairman -- served for 17 and 13 years respectively.

As a consequence, a distinguishing characteristic of the Program is its strong continuity. One manifestation of this continuity is that the Program's time horizon is relatively long. This has eliminated the need for quick successes which may be detrimental in the long run. It also enables the Program to be patient with hospitals -- an approach that is often fruitful. As a hypothetical example, the Rate Review Committee can say to a hospital:

> We are concerned about your cost position this year, but we are willing to go along with the changes that you propose. However, if these changes aren't implemented or if they don't work, it will be necessary to consider other options next year.

Another manifestation of the Program's continuity is that changes in the system have been gradual and evolutionary. Even so, the Program has been characterized by steady change. As an example, Mr. Jones

no longer works as closely with the Program as he did previously. Joseph Toussaint, an IBC senior vice president in the Budget and Management Division, assumed direct line responsibility for the operation of the Program when the Rate Review Staff was transferred to his division in 1974. As another example, Mr. TeKolste is not quite as involved with the Program as he was earlier. Some of his responsibilities have been assumed by C. L. Morris, now IHA executive vice president and a provider RRC member during the early 1970s. As yet another, Mr. Malasto and Mr. Lobley who were important RRC members for many years no longer serve on the Committee.

At present the longest tenure of any provider RRC member is six years. While several public members were appointed in the 1960s, a number of others are recent appointees. In general, the changes in RRC composition across time have been accomplished smoothly without impairing the Committee's effectiveness. At a minimum there is no indication that any single Committee member is or was indispensable to the Program.

3.
Control Environments

This study emphasizes comparison of Indiana hospitals with control hospitals. The nature of the control hospitals is thus of central importance. This chapter is addressed to this general topic. Its specific subject is the nature of the control environments, with Chapter 5 then describing the selection of the control hospitals themselves.

This chapter begins by developing the framework for control group selection. It identifies four general types of control groups that could have been used in this study, and discusses the rationale for the selection of the two types that are employed. The next chapter section discusses the selection of the specific states to represent the control environments. The chapter then depicts the dominant characteristics of hospital payment/planning programs in the states comprising the study's Type I and Type II environments. Its third section is directed toward the Type I environment, and its last section toward the Type II environment.

A key source of information for this chapter was a series of on-site and telephone interviews with individuals in the actual and potential control states. Such interviews included Blue Cross executives, hospital association staff members, government officials, hospital administrators, and state legislators. Written correspondence proved a valuable adjunct to these interviews. In addition, reports and less formal documents were reviewed when they were available.

Framework for Control Group Selection

Since this study emphasizes comparison of Indiana and control hospitals, the nature of the control hospitals is of central importance. In this regard the most fundamental question is what types of factors should these hospitals "control for." That is, in terms of which factors should there be systematic differences between Indiana and control hospitals? Or expressing the same question differently, with which hospital regulatory settings should the Indiana Program be compared?

As described in Chapter 2, the Indiana Program has strong prospective rate setting and planning elements. The following types of control groups could thus have been used in this study.

- Type I -- Weak (or no) prospective rate setting and planning
- Type II -- Strong planning, but weak (or no) prospective rate setting
- Type III -- Strong prospective rate setting, but weak (or no) planning
- Type IV -- Strong prospective rate setting and planning, but with different characteristics than the Indiana Program

Inclusion of a Type I control group is directed toward the most fundamental type of comparison because it asks the question: What are the effects of the Indiana Program compared to settings with few rate review or planning restrictions? Evaluation in such terms is important for two reasons. First, it is the most basic comparison. Second, although the political impetus toward rate setting and planning is strong at both national and state levels, it remains a viable alternative to place few regulatory constraints on hospitals. A Type I control group was therefore included in this study.

Use of a Type IV control group was rejected because this project's purpose was not to directly compare through quantitative analysis the effects of the Indiana Program and other prospective rate setting programs. While a Type III control group is a theoretical possibility, in actual practice there are no strong prospective rate setting programs in this country which operate in areas characterized by the absence of a planning program.

In contrast, a number of states are characterized by strong planning programs and weak or nonexistent rate setting programs, i.e., by a Type II setting. In 1973, the last main study year, more than 25 states had planning programs similar to Indiana's or certificate of need laws requiring that major capital expenditures be approved by planning agencies. Only a handful of such states had strong rate setting programs, operated by either Blue Cross plans or state agencies.

At the federal level, Public Law 92-603, passed in 1973, requires under the 1122 program that substantial hospital capital projects be approved by planning agencies in order for the capital and interest expenses of such projects to be eligible for Medicare and Medicaid reimbursement. This law specifies that existing prospective rate setting programs be evaluated and that rate setting experiments be conducted. However, it does not require approval of hospital costs by a rate setting program prior to reimbursement by the federal financing programs. Public Law 93-641, enacted in 1974, mandates the creation of larger planning agencies and the passage of certificate of need laws by all states. While it establishes experimental authority for support of a limited number of state rate setting programs, it does not mandate the creation of such programs on a national basis.

A realistic alternative to rate review programs is therefore planning by itself, i.e., capital expenditures regulation without rate regulation. In fact, this alternative characterizes the present environment of many states in this country. From a policy perspective it is thus as important to compare the Indiana Program with a Type II control group as with a Type I control group. For this reason both types of control groups are included in this study.

Selection of Control States

Two sequential steps were employed to select the control hospitals. The first step, described in this section, created pools of potential control hospitals specified in terms of states (or large substate areas). The second step selected the specific control hospitals from these pools -- a task described in Chapter 5.

The general criterion for control state selection was that such states should differ from Indiana in terms of hospital payment/planning programs, but should closely resemble Indiana in terms of all other important factors impacting hospitals. This criterion arises directly from the precept that Indiana is the point of reference in this study. That is, the central question is: What is the impact of the Indiana Program on Indiana hospitals? This question could best be answered by comparing Indiana hospitals with two groups of control hospitals precisely identical to Indiana hospitals, except that one group would be located in a Type I environment and the other in a Type II environment.

This ideal goal can never be fully realized in social science research. It nevertheless provides a clear guideline for the selection of control groups. That is, the environments of Indiana and control hospitals should be similar with the single exception of hospital payment/planning programs. Further, the use of regression analysis in this study means that it is not necessary to fully attain this goal. As long as Indiana and control hospitals are relatively similar, regression analysis will separate the impact of the Indiana Program from the effects of other variables.

Three specific conditions derived from these general principles were used to select the control states for this study. First, a control state had to be characterized by either a Type I or Type II hospital payment/planning environment. Second, the state had to be located in the Midwest,[1] so that region would not be a factor varying systematically

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[1] In this study the Midwest is defined as the North Central Region, a geographic area specified by the Bureau of Census. It includes Michigan, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

with the Indiana Program. Third, the state had to be similar to Indiana in terms of important statewide characteristics (i.e., state exogenous variables).

In selecting the control states, primary consideration was given to the Midwestern states contiguous to Indiana -- Michigan, Illinois, and Ohio. The latter was considered unsatisfactory as a control state for two reasons. First, as discussed in Chapter 26, for more than a quarter century Blue Cross of Southwest Ohio has operated a prospective rate setting program similar to the Indiana system. Many Ohio hospitals near the Indiana border function under this program. Second, at the time of data collection the remainder of Ohio was served by six Blue Cross plans, thereby complicating the logistics of data collection.

Both Illinois and Michigan met all three selection criteria: Illinois, with weak planning and no rate review, represented a Type I environment; and Michigan, by virtue of its active planning component, represented a Type II environment. These characteristics are discussed in detail later in this chapter.

Because of the desirability of having large numbers of hospitals in the control pools, other states in the North Central Region were considered as possible control states. As described in Chapter 26, a prospective rate setting program similar to the Indiana system was first initiated on an experimental basis in Wisconsin in 1972. Since for this reason it might not have provided a clear-cut contrast with Indiana during the study years, Wisconsin was rejected as a control state.

Two Blue Cross plans serve Missouri. As also described in Chapter 26, since 1972 Blue Cross of Kansas City has administered a prospective rate setting program which resembles the Indiana system. Hence, that part of Missouri served by this plan was excluded as a potential control area. The remainder of Missouri, served by Blue Cross of St. Louis, was eventually rejected because of its relative dissimilarity to Indiana. The four states in the western tier of the North Central Region -- North Dakota, South Dakota, Nebraska, and Kansas -- were rejected as control states because of their socio-demographic divergence from Indiana.

Minnesota was found to be acceptable in terms of the three selection criteria. A certificate of need law was passed in that state in 1971, but as described later in this chapter, the prevailing opinion in Minnesota is that the resulting program was not an effective entity during the main study years. Accordingly, since Minnesota did not have a cost control program during the study years, this state was placed in the Type I control pool. Iowa also satisfied the three selection conditions. Since this state had neither an active planning nor rate review program, it was placed in the Type I control pool.

The pools were then fine-tuned to eliminate hospitals which would have posed logistical difficulties or represented unsuitable controls for Indiana hospitals. Michigan and Minnesota are each served by only one Blue Cross plan. Blue Cross of Minnesota contracted with essentially all short-term hospitals in the state during the study years. Twenty-three percent of Minnesota's population were Minnesota Blue Cross subscribers. However, two Minnesota hospitals substantially involved in operational utilization review programs were deleted from the Type I pool.

Sixty percent of Michigan residents are insured by Blue Cross of Michigan. As in Minnesota, all hospitals in Michigan contracted with Blue Cross during the main study years. However, 12 Michigan hospitals were involved in the Michigan Blue Cross prospective payment experiment initiated in 1973. These institutions were therefore excluded from the Michigan pool of potential control hospitals.

Both Illinois and Iowa have two Blue Cross plans. In Illinois, the small Rockford Blue Cross plan contracted with only eight hospitals during the study period; Chicago Blue Cross contracted with 258 Illinois hospitals, approximately half of which are in the Chicago area. The subscriber penetration rate of the Chicago plan was 30%, less than the corresponding Indiana Blue Cross rate. Blue Cross of Iowa contracted with 92 of Iowa's 136 short-term general hospitals, spanning 73 of the 99 Iowa counties. Its subscriber penetration rate, 43%, modestly exceeded that of Indiana Blue Cross. The smaller Iowa plan, Blue Cross of Western Iowa and South Dakota, served the remaining hospitals in the state.

To increase the efficiency of data collection, hospitals in Illinois and Iowa contracting with the smaller Blue Cross plans were eliminated from the Type I control pool. All hospitals in these two states included in this pool are thus served by the dominant plans: in Illinois, by Chicago Blue Cross, and in Iowa, by Iowa Blue Cross.

In summary, the Type I control hospital pool, or the Tristate pool, consists of hospitals in Illinois, Minnesota, and Iowa, excluding those hospitals specified above. The Type II control hospital pool, or the Michigan pool, is comprised of all Michigan hospitals with the exception of those institutions participating in the prospective payment experiment.

Characteristics of the Tristate Environment

In the three states representing the Type I environment there were no hospital cost control programs administered by the state government

during the main study years.[2] As in the country generally, the Medicare and Medicaid programs paid hospitals on a retrospective cost basis. Commercial insurers followed their customary practice of either paying hospital charges directly or indemnifying their beneficiaries who in turn paid hospital charges. Self-paying patients also recompensed hospitals on the basis of billed charges.

Unlike Indiana, none of the Blue Cross plans in the Tristate environment operated a prospective rate setting program during the study period. Instead, all relied on retrospective cost-based reimbursement. While there are modest differences in their reimbursement methodologies, there are stronger commonalities.

Chicago Blue Cross (CBC) paid its member hospitals their full billed charges on an interim basis. Although CBC required 90-day notice from hospitals prior to implementation of rate increases, the increases were generally approved without any cost or other justification from hospitals. Adjustments, if any, to the interim Blue Cross payments were made at the end of the fiscal year. At that time a desk audit was performed by the hospital's accountants and was examined by CBC staff to determine whether charges paid were within 105% of the hospital's total cost. Free care, bad debts, and funds for working capital were not considered reimbursable costs, and had to be covered in the 5% plus factor.

With return from the hospital of all payments exceeding the 105% ceiling, or with additional payment to the hospital if interim payments fell below that ceiling, the settlement process was complete. Chicago Blue Cross exercised little scrutiny over the hospital's prepared financial statement unless it found obvious irregularities in the submitted forms. Significant cost constraints were not imposed by this Blue Cross plan on member hospitals.

Iowa Blue Cross (BCI), like Chicago Blue Cross, reimbursed its hospitals for the lesser of cost-plus-5% or charges. An annual two-stage audit was conducted by BCI to rectify differences in actual payments (paid on the basis of billed charges during the year) and reimbursable payments.

The first step of the audit, conducted in the hospital, was intended to assure Iowa Blue Cross that charges submitted for services rendered to Blue Cross patients were identical to charges for non-Blue Cross patients. This revenue audit also assured BCI that submitted charges were for appropriate reimbursable services and that all contracts with outside firms (e.g., a commercial laundry) were in order. The second

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[2] This chapter describes the environment in these states during the main study time period, 1968 through 1973. Recent developments are discussed in Chapter 26.

step of the annual audit was also conducted within the hospital by BCI staff. Like Medicare audits, the focus of this audit step was on cost, not revenue. It consisted of an examination of allowable and unallowable costs. As part of this process, the hospital's "carve out" for Medicare was reviewed to determine if it had been done correctly. At no point was justification of costs a required element of this audit step.

Minnesota Blue Cross (BCM), the other dominant payer in the Tristate control group, also focused on costs under its controlled method of hospital reimbursement. This method, which was available to all contracting hospitals, paid hospitals on an interim basis at 90% of billed charges. Tentative settlements were available on a quarterly basis, but final retroactive settlement was made on an annual basis. At the time of final settlement (i.e., within 120 days following the end of its fiscal year), each hospital submitted to Blue Cross an annual cost report. Controlled hospitals were also subject to an annual BCM audit performed in conjunction with the Medicare audit.

Final reimbursement was based on the lesser of costs or charges. Beyond actual costs, BCM allowed controlled hospitals a margin or plus factor. This included an allowance in lieu of actual bad debts and charity allowances, equal to .5% of gross patient billings; and an allowance to provide for reserves, contingencies, and hospital service improvements, all of which amounted to a plus factor usually equalling 4% to 6% of costs.

Minnesota Blue Cross offered another reimbursement approach, termed the decontrolled method, to hospitals which had less than 2,500 Blue Cross patient days per year. All hospitals not meeting the size criterion had to accept the controlled method of reimbursement, while those satisfying the size requirement could elect either method. Because it was administratively simpler and entailed fewer restraints, the great majority of the latter hospitals chose the decontrolled method. As decontrolled providers these comparatively small hospitals received interim Blue Cross payments at 97% of charges with no retroactive settlement -- interim payments were final. Unless BCM specifically requested one, no annual cost report or audit was required from these hospitals.

During the main study years the states comprising the Tristate environment were similar in that the Blue Cross plans did not attempt to control hospital capital expenditures through a planning program. There were, however, modest differences in certificate of need activity in these states. During the study years Iowa had no certificate of need law, not enacting such a law until 1977. Illinois did adopt a certificate of need law during the study years, but not until mid-1973, at the very end of the study period. Minnesota created a certificate of need program somewhat earlier, in 1971, but the general consensus in that state is that this program was not an effective reviewer of capital expenditures during the study years.

None of these states thus had a certificate of need or Blue Cross planning program which effectively regulated hospital capital expenditures incurred during the study years. Similarly, reflecting the situation throughout the country, the 1122 program did not affect capital expenditures in these states during the study period. These points are reinforced by the long period of time that generally occurs between planning agency approval of a capital project and the completion of that project. Accordingly, even if the Minnesota certificate of need program had been effective in 1973, its decisions would not have made an appreciable impact on hospital capital expenditures in that year.

Illinois, Minnesota, and Iowa therefore exhibited the necessary characteristics of a Type I environment. In none of these states was there a prospective rate setting program, under the aegis of either public or private entities. Each state had at most only a weak planning program.

Characteristics of the Michigan Environment

As in the Tristate areas, during the main study years there was no state cost control program in Michigan.[3] The Medicare and Medicaid programs paid hospitals in the same way in Michigan as they did in Illinois, Minnesota, and Iowa. The same is also true for commercial insurers and self-paying patients.

The method of reimbursement used by Michigan Blue Cross (MBC) was largely similar to those employed by the Blue Cross plans in the Tristate environment. For example, like the latter, the former paid hospitals the lesser of charges or costs (including a plus factor). The most important differences between the Michigan and Tristate reimbursement methods were twofold. First, Michigan Blue Cross employed much more extensive cost auditing. Second, this Blue Cross plan used a cost ceiling technique designed to limit reimbursement to hospitals whose costs far exceeded those of their peers.[4]

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[3] As with the Tristate environment, this chapter characterizes the Michigan environment during the main study years, 1968 through 1973. The newly-established Michigan prospective rate setting program is discussed in Chapter 26.

[4] The seven peer groups into which Michigan hospitals were clustered were determined by hospital size and location. Unlike the Indiana Program's methodology, MBC used these two factors together rather than separately to create the groups, which were: Greater Detroit area hospitals with 150 or fewer beds; Greater Detroit area hospitals with more than 150 beds; Flint-Saginaw area hospitals with 150 or fewer beds; Flint-Saginaw area hospitals with more than 150 beds; Lower Peninsula hospitals with 150 or fewer beds, Lower Peninsula hospitals with more than 150 beds; and all Upper Peninsula hospitals.

The MBC reimbursement system automatically allowed a 2% community improvement factor for inpatient costs, thus insuring at least a 102% cost reimbursement to each hospital if its cost increase ceiling (CIC) was not violated. The community improvement factor for outpatient costs was higher, 6%. Further, outpatient costs were not subject to the CIC limitation.

From the hospital's year-end submission of its cost report to determination of its final reimbursement, the procedure was as follows. A desk review by MBC staff confirmed the accuracy and completeness of the hospital's cost report as submitted. Additional information was secured from the hospital if the report was incomplete. If after the additional items were examined still further audit was indicated, the scope of the audit was determined and MBC resources were scheduled to implement it.

After the desk audits had been completed, a tentative settlement was reached consisting of a 90% reimbursement to the hospital for its outstanding Blue Cross liability (total Blue Cross liability minus interim payment of charges). If at this point MBC felt that further audit was indicated, a field audit was conducted.

Final settlement was made after the completion of the field audit (if any). However, that settlement was subject to the CIC limitation. It was thus not until this point in the reimbursement process that the hospital grouping procedure applied. Similarly, not until this point did a hospital know its cost status within its peer group. Over time a Michigan hospital could well familiarize itself with the cost pattern of its peers, either through the annual CIC calculation, available cost reports, in-group exchange of information, or other methods. Even so, it remains true that a hospital's cost status in relation to its peers was formally determined retrospectively.

The first step in the CIC calculation was to use base year costs (i.e., costs in the year prior to the settlement year) to establish the hospital's relative position within its peer group. To effect this step, the cost of each hospital in the peer group was compared to the average cost for all hospitals in the group. For example, if the peer group's average cost was $80 per day, and if Hospital A's cost was $68 per day and Hospital B's cost $85 per day, the relative positions of these two hospitals would be 85% and 106% respectively.

For each hospital, the maximum allowable cost increase from the base year to the current year was derived from application of an algorithm. The algorithm was based upon the average increase in per diem cost of all hospitals in the peer group and the relative position of the individual hospitals. To continue the above example, according to the algorithm, Hospital A with a relative position of 85% would be allowed a current year increase up to 200% of the group inflation rate; Hospital B at a 106% relative position would be permitted an increase no higher than 150% of the group increase.

No base year-to-current year increase was permitted for hospitals with a relative position of 125% or greater. However, since the hospital's cost in the current year became the base for the next year, the CIC limitation did not extract cumulative penalties from these high cost hospitals.

In two instances the CIC was automatically inapplicable. First, new facilities (including old hospitals in a new building) were granted a year's grace period to re-establish relative position. Second, hospitals undergoing major capital expansion were partially relieved from the impact of the expansion.

The great majority of Michigan hospitals were not affected by the cost increase ceiling. Even for those institutions that were affected, relief could be forthcoming if the excessive cost increase resulted from reduction in length of stay, and thus total patient days. Like other elements in the Michigan program, the level of relief in this instance was determined by a preset formula. A hospital could also appeal its reimbursement settlement from a policy interpretation standpoint or for particularly extenuating circumstances. Such appeals, occasionally successful, resulted in retroactive adjustment.

While the CIC technique decreased Blue Cross payments to a few hospitals, it is the general consensus in Michigan that it was not an effective regulatory mechanism moderating costs in most Michigan hospitals. At a minimum it was not a prospective rate setting program similar to Indiana's. Thus, consistent with the Type II characterization, during the study period Michigan is distinguished by having no prospective rate setting program and a system of weak retrospective cost controls.

In contrast, from the early 1960s Michigan hospitals have been subject to the approbation of planning programs. Specifically, beginning in 1960 for new hospitals and in 1963 for existing hospitals, a provision of the MBC contract with hospitals has required that hospital capital expenditures be in accord with community need and appropriate planning principles.

In most instances the capital expenditures review function was undertaken by local planning agencies, but in a few cases it was carried out directly by Blue Cross staff, especially in the program's early years. In either instance the review findings were forwarded to the Qualifications Subcommittee of the Hospital Relations Committee, which is in turn a committee of the MBC Board of Directors.

The Qualifications Subcommittee consisted of three to four hospital administrators. Its general task was to evaluate MBC contracts with hospitals. Within this role its largest responsibility was to assure hospital compliance with planning decisions. The penalty for hospitals not conforming was loss of the MBC contract.

The penalties for noncompliance with planning principles are thus different in the Indiana and Michigan programs. As noted earlier, the penalty in the Indiana Program is nonpayment of the involved capital expenses -- a more focused sanction than the Michigan program's. In theory this might lead to differences in the programs' effects. In practice it did not because hospitals functioning under the Indiana Program did not proceed with capital projects for which they would not be paid.

While the scope of the Michigan planning system extended to all types of substantial capital projects, its main focus was the restraint of hospital bed expansion, either in the form of additions to existing facilities or establishment of new institutions. This emphasis on bed growth has been a characteristic of this planning program since its inception.

The MBC planning program continued through 1973 when it was superseded by the enactment of a state certificate of need law. During its existence the program was systematically enforced by Blue Cross. At times hospitals complained vigorously about the program's decisions. However, no hospital successfully defied the program by continuing with unapproved capital expansion and accepting loss of its Blue Cross contract -- an action which would have placed the hospital in financial jeopardy, but which at the same time would have put Michigan Blue Cross in a difficult political position.

Michigan thus meets the other requirement of a Type II environment. During the study years it was characterized by the presence of a strong planning program reviewing hospital capital expenditures. Further, like the planning component of the Indiana Program, this program began in the early 1960s -- an important point because of the substantial period of time usually consumed by hospital capital expansion. The planning programs in both Michigan and Indiana were thus in existence sufficiently long that their decisions would be expected to affect capital expenditure patterns during the study years.

The relationships between the Economic Stabilization Program (ESP) and the Indiana Program are described in the previous chapter. While these relationships are significant, the most important change produced by ESP in terms of this study is that it altered the nature of the Michigan and Tristate control environments. Before ESP the control states were characterized by the absence of hospital rate setting programs. In contrast, during ESP the control hospitals were subject to the regulations of that program.

During the latter part of the main study period, this project thus contrasts the impact of the Indiana Program and ESP with the influence of ESP alone in the Tristate environment, and with the impact of ESP and planning in the Michigan environment. As discussed in Chapter 10, it is therefore possible that during the later study years ESP decreased the apparent impact of the Indiana Program in the study analyses.

III.

Common Methodology of Segments I-III

While there are important differences among the first three segments, they are based on a common methodologic framework. The objective of Section III is to describe this framework; each of its chapters plays an important role in this effort.

Chapter 4 addresses issues at the core of the common methodology. It develops the model for the regression analyses and describes the structure of those analyses. Chapter 5 describes the selection of the hospital samples employed in the first three segments. It closely examines the comparability between these samples and the Indiana hospital universe.

Chapter 6 discusses the analytical techniques used in these segments, concentrating on regression analysis -- the primary analytical instrument. This chapter describes the derivation of the Indiana Program's percentage impact statistic which is used extensively to present the study results. The topic of Chapter 7 is the main data sources employed. Like the other chapters in this section, it is analytical rather than descriptive in tone, stressing the rationale for the selection of each source.

The common subject of Chapters 8 and 9 is three generic types of variables: hospital exogenous variables, local exogenous variables, and semi-exogenous variables. The former chapter reviews the substantive rationale for including or excluding specific variables within these generic types. The latter chapter describes the construction of the measures used in the analyses to represent the included variables.

4.
Analytical Framework

This chapter addresses five topics central to the study methodology. The first is the model for the regression analyses, whose development includes the definition of exogenous, semi-exogenous, and endogenous variables. The second topic is the unit of analysis employed in the first three study segments.

The discussion of the third topic -- the time dimension -- encompasses specification of the main study time period and consideration of whether substantial cost differences existed between Indiana and control hospitals prior to the Indiana system's implementation. The fourth topic is state exogenous variables. The crucial question here is: Are there variables substantially impacting hospitals which vary systematically between Indiana and the control states?

The final topic is the structure of the regression analyses. The chapter section devoted to this topic is both definitional and substantive. For example, the section defines the annual analyses and then discusses why the cost differences between Indiana and control hospitals in these analyses represent the impact of the Indiana system.

Model for the Regression Analyses

The first study objective is to determine if the Indiana Program reduces hospital cost. This cannot be satisfactorily accomplished simply by comparing average hospital costs in Indiana and control states. Nor can it be achieved just by correlating Indiana and control hospital costs. The reason is that variables other than the Indiana Program influence hospital costs. Their effects must be taken into account in order to accurately assess the Program's impact on hospital costs. That is, it is essential to consider the effects of exogenous variables, i.e., variables which influence hospital cost, but which are not affected by the Indiana Program.

It is also necessary to take into account factors which are termed semi-exogenous variables, all of which must meet one condition: It must be reasonably likely that they affect hospital cost. As discussed in Chapter 8, they must also meet either of two additional conditions. The first is that substantive reasons must make it desirable to separate the variable's cost effect from the Program's cost impact. The alternative condition is that there must be a low but still finite probability that the Program influences the variable.

Hence, the first analysis step, termed Step A, determines the influence of the Indiana Program on hospital cost, taking into account both exogenous and semi-exogenous variables. Step A is directed toward the first study objective and by itself is sufficient for the attainment of that objective.

The second analysis step, termed Step B, determines the Program's impact on variables representing other aspects of hospital performance. Like hospital cost, some of these variables have normative value in that policymakers and others usually value more (or less) of the variable, independent of its impact on hospital cost. Others are primarily of interest because they may affect hospital cost. Some variables like hospital quality are important for both reasons. Hospital net worth is a variable with normative value, but it has little direct influence on cost; hospital labor productivity has inappreciable normative value, but may substantially impact cost.

Hospital performance variables such as quality, net worth, and labor productivity are termed endogenous variables and are defined as variables satisfying two conditions. First, they may be influenced by the Indiana Program; and second, they have normative value and/or may affect the primary dependent variable, hospital cost.[1] In assessing the Program's impact on these variables it is important to consider exogenous and semi-exogenous variables. Some of these variables may be the same as those influencing hospital cost in Step A, while others may be different.

Stated precisely, Step B determines the impact of the Indiana Program on endogenous variables (excluding hospital cost), taking into account exogenous and semi-exogenous variables. This step is directed toward the second and third study objectives. By itself it is sufficient for the attainment of the latter objective, but an additional step is necessary for the achievement of the second objective, as discussed below.

The Indiana Program can only affect hospital cost through endogenous variables, since by definition exogenous and semi-exogenous variables are beyond the Program's influence. Two conditions must be satisfied for the Program to impact cost through an endogenous variable. First, the Program must affect the endogenous variable. Step B estimates the magnitude of such effects. Second, the endogenous variable must influence cost. The purpose of the third analysis step, termed Step C, is to examine the extent to which this condition prevails, i.e., to analyze the effects of the endogenous variables on cost.

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[1] Hospital cost is also an endogenous variable since it may be influenced by the Indiana Program. Even so, it is useful from a substantive viewpoint to make the distinction between hospital cost -- the primary dependent variable -- and other endogenous variables.

In these analyses only those variables directly affecting cost are taken into account. Exogenous variables and the Indiana Program are excluded since they affect cost by influencing endogenous variables.[2] Many endogenous variables influence cost directly, but others have little cost impact, as pointed up earlier. Semi-exogenous variables can also influence cost directly; an example is hospital emergency/outpatient involvement.

In precise terms, Step C determines the effects of endogenous variables on cost, taking into account those endogenous and semi-exogenous variables which directly influence cost. This step completes the process, begun in Step B, of identifying the variables through which the Indiana Program influences cost. Together these two steps result in the attainment of the second study objective. To illustrate this point, assume that Step B shows that the Indiana Program has a -10% impact on average salary and that Step C indicates that a 10% decrease in average salary reduces cost by 8%. The Program's effect on cost transmitted through average salary is therefore -8%. Accordingly, in this example it is an important variable through which the Program influences cost.

Figure 4-1 summarizes these discussions by showing the relationships among the Indiana Program and the different types of variables. In this figure the expected impact of one factor on another and the direction of that impact are shown by a solid arrow, e.g., the expected effects of exogenous factors on endogenous variables. The lack of impact of one factor on another is indicated by the absence of an arrow. The special relationship between the Indiana Program and semi-exogenous variables is shown by the dashed arrow; and the effect of the Indiana Program on cost, which is transmitted through endogenous variables, is indicated by the dotted arrow.

In Step A the objective is to determine the influence of the Indiana Program on cost. Hence, the endogenous variables are excluded from this step, which estimates the magnitude of the dotted arrow (A). In Step B the intent is to determine the effects of the Indiana Program on endogenous variables. Consequently, costs are excluded from these analyses which estimate the size of the solid arrow (B). The purpose of Step C is to analyze the effects of endogenous variables on cost. Hence, the exogenous variables and the Indiana Program are excluded, and the magnitude of the solid arrow (C) is estimated. Steps B and C thus analyze the components of the overall relationship between the Indiana Program and hospital cost established by Step A.

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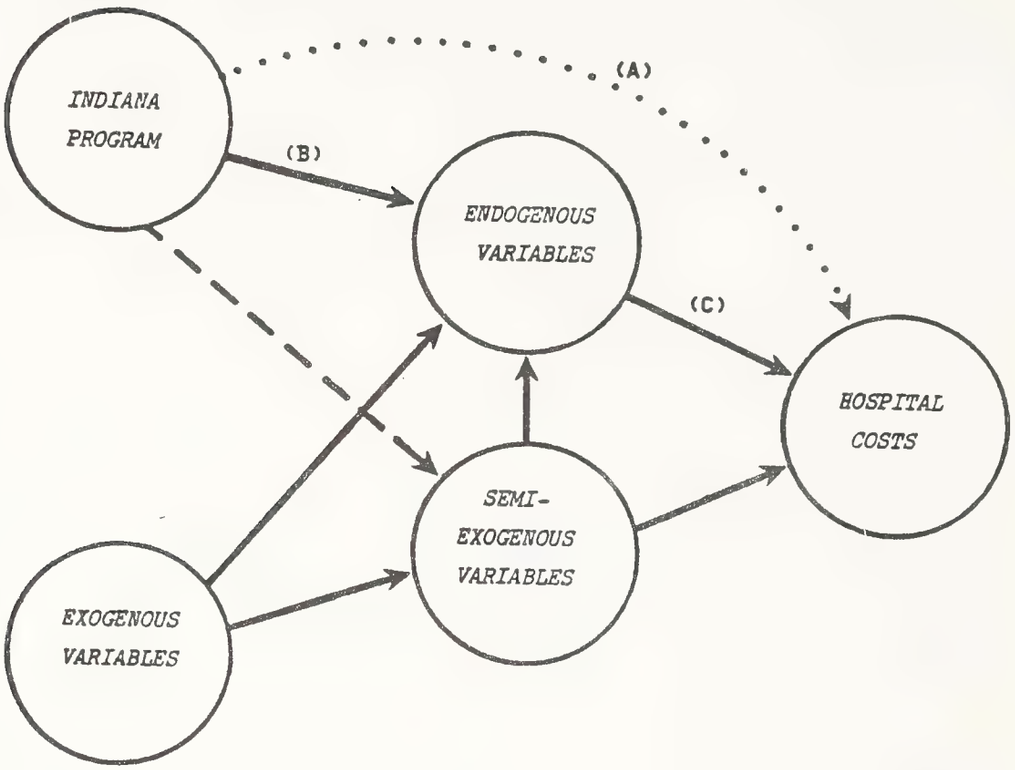
[2] As an illustration, consider exogenous variable A which influences cost by affecting endogenous variable Z. If variable A were included in these analyses, its presence would reduce the influence of variable Z, thereby producing an underestimate of the true effect of variable Z on cost.

Figure 4-1

SCHEMATIC MODEL FOR THE REGRESSION ANALYSES



The model depicted in Figure 4-1 is the framework for the regression analyses conducted in Segments I-III. These segments are framed primarily in terms of data availability. As a consequence, it is impossible to conduct the three analysis steps in sequence, i.e., Step A in Segment I, Step B in Segment II, and Step C in Segment III. Nor is it advisable to include the three steps equally in each segment. Accordingly, the steps receive similar emphasis in Segment I, but Step B is stressed in Segments II and III, although these segments also include elements of the other steps.

Unit of Analysis

The individual hospital is the unit of analysis in Segments I-III. This approach ensures a sufficient number of observations as compared to the use of larger units of analysis, such as a hospital market area. There are approximately 110 community hospitals in Indiana, but no more than 15 hospital market areas.

Compared to smaller units of analysis, such as the hospital department, the entire hospital is a more independent and integral unit

since linkages across hospital departments are strong. Although hospitals are influenced by organizations outside their boundaries, they are intended to function as generic wholes. In contrast, departments are designed to operate as highly interrelated entities within the hospital.

The Time Dimension

From a research design perspective this study presented a basic dilemma. On the one hand, it is desirable in social science research to conduct controlled before/after analyses. In such a design Indiana and control hospitals would be compared before and after Program implementation. On the other hand, the Indiana Program was instituted in 1960 and hospital data was limited at that time. It was therefore not feasible to perform a comprehensive before/after analysis of the Indiana Program.

Rather, it was necessary to use a time period substantially after the Program's implementation -- the six-year span from 1968 through 1973. The latter year was selected since it was the most recent year for which complete data was available during this project's main data collection stage. 1968 was chosen both because of data availability and because it was beyond the start-up effects of the Medicare program.

This purely "after" research design is not ideal. However, since the study design readily permits the use of controlled comparisons to evaluate the Indiana Program, it is sufficiently sound to produce penetrating results about the impact of the Indiana Program. In addition, the main study findings were broadened by conducting a time trend analysis which compares the average costs of Indiana and control hospitals from 1958 through 1976.

The regression analyses are based on the main study time period, which is the span from 1968 through 1973. In these analyses the Indiana Program is represented by a dichotomous index in which (1) signifies an Indiana hospital and (0) a control hospital. If the analyses show that this index has a significant impact on the percentage change in hospital cost between 1968 and 1973, given that certain other conditions are satisfied (as will be discussed), such an impact is attributable to the Indiana Program which was operational during this entire time period.

However, if the regression analyses show that this index has a significant influence on hospital cost in either 1968 or 1973, such an influence is more difficult to interpret from a causative standpoint. The Indiana Program not only functioned in 1968 and 1973, but also in the eight years preceding 1968. Hence, the cost impact of the Indiana Program Index in 1968 or 1973 could be due to the Program and/or to possible cost differences between Indiana and control hospitals in 1960.

Tables 4-1 and 4-2 are illuminating in this regard. The former shows average Indiana hospital cost (cost per case) in 1960, 1964, 1968, and 1973; and the latter indicates the percentage changes in average cost between selected pairs of these years.[3] As indicated, Indiana hospital costs increased substantially during this period. Between 1960 and 1964, hospital costs rose in Indiana, but relatively slowly compared to later years -- an increase of 25%. During the next four years, hospital costs increased by 58%; and during the study years, 1968 through 1973, by 61%.

Table 4-1

AVERAGE INDIANA HOSPITAL COST

	1960	1964	1968	1973
Average Cost	$200	$249	$393	$634

Table 4-2

PERCENTAGE CHANGE IN AVERAGE INDIANA HOSPITAL COST

	%Δ '60-64	%Δ '64-68	%Δ '68-73	%Δ '60-68	%Δ '60-73
Average Cost	25%	58%	61%	97%	217%

Between 1960 and 1968 hospital costs increased by 97%. Hence, Indiana hospital cost in 1968 is comprised of two approximately equal components -- 1960 cost levels which were not influenced by the Indiana Program, and the increase in hospital costs between 1960 and 1968 which may have been affected by the Program. During the entire time period from 1960 through 1973, the increase in hospital cost was much larger, 217%. Indiana hospital cost in 1973 is thus composed of two components of unequal size -- 1960 cost levels and cost increases between 1960 and 1973. The latter, which are under the Program's potential influence, are more than twice as large as the former.

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[3] These tables are based on the 65 Indiana hospitals which have complete data for cost/case in the AHA Survey (described in Chapter 7) for the four years indicated.

If 1960 cost had been 10% higher in control hospitals than in Indiana hospitals (i.e., a dollar difference of $20), and if that dollar difference had been maintained between 1960 and 1973, it would have appeared in 1968 as a 5% cost difference between Indiana and control hospitals; and in 1973 as a 3% difference. The sheer magnitude of post-1960 hospital cost increases thus makes it unlikely that substantial 1968 or 1973 cost differences between Indiana and control hospitals are mainly due to cost differences pre-existing the Program.

Equally important, there is no substantive reason to expect that 1960 hospital cost was substantially lower in Indiana hospitals than in control hospitals. Prior to the Indiana Program, no hospital cost control programs existed in Indiana or the control states. Similarly, before 1960 there were no private or governmental capital expenditures review programs. No suggestion emerges, either from early Program documents or from the project site visit discussions, that the Program's creators considered hospital costs to be lower in Indiana than in similar states. On the contrary, as a general rule, it seems remote that low hospital costs would stimulate the development of a prospective rate setting program. Instead, it seems much more likely that high costs would be an instrumental factor.

It is thus highly unlikely that cost differences between Indiana and control hospitals during the study years are primarily, or even appreciably, due to cost differences between such hospitals in 1960. Consequently, the cost impact of the Indiana Program Index must be attributed to the Program, rather than to cost differences predating the Program.

State Exogenous Variables

A state exogenous variable characterizes in approximately the same way all hospitals in the state or states involved. The Indiana Program is such a variable. It was found only in Indiana; during the main study years no control state had a prospective rate setting program similar to the Indiana system. Equally significant, the Indiana Program is applied to all hospitals in that state in approximately the same way. For example, northern Indiana hospitals are not regulated more or less rigorously than southern Indiana hospitals. Similarly, the Program uses the same approach to review urban and rural hospitals, and large and small hospitals.

The Indiana Program can thus be represented by a dichotomous index. However, other state exogenous variables would interfere with the interpretability of this index if they varied systematically across the study hospitals in a manner highly similar to the Indiana Program. That is, analytical difficulty arises if such variables are either present for Indiana hospitals and absent for control hospitals, or absent for Indiana hospitals and present for control hospitals.

Region of the country is an important exogenous variable since it has a substantial influence on hospitals, independent of county socio-economic characteristics. Hence, to prevent region from interfering with the interpretability of the Indiana Program Index, each control state had to be located in the Midwest, as discussed in Chapter 3.

Differences exist among the study states in terms of coverage of the medically needy under the Medicaid program. Minnesota and Michigan define the medically needy in liberal terms, while Illinois extends coverage to this group, but defines it more stringently. Neither Indiana nor Iowa cover the medically needy. However, this Medicaid program characteristic does not compare to the Indiana Program in terms of potential impact on hospitals. On average, less than 5% of study hospital cases are Medicaid recipients. In marked contrast, the rates established by the Indiana Program control the size of the hospital's total budget. Further, the hospital benefits provided to Medicaid recipients are essentially the same in all study states, as is the Medicaid definition of the categorically needy.

Another potentially important factor is state or regional utilization review (UR) programs. During the study years Indiana had only the rudimentary UR program of IBC which consisted primarily of procedures required by the public insurance programs. A similar situation prevailed in Michigan and Iowa. In Illinois the Hospital Administration and Surveillance Program (HASP) was instituted in 1972 to review hospital care. However, it covered only Medicaid patients and required several years to become fully operational. Two Minnesota hospitals were involved in a UR program sponsored by the Metropolitan Health Care Foundation, but both were eliminated from the potential Tristate control group.

Another state characteristic is the extent of the state insurance department's involvement in health care. Such involvement has been only peripheral in Indiana. The same situation characterized the control states during the study period. Similarly, there were no significant differences among the study states in terms of hospital licensure programs.

Among others, Bauer and Clark (1974) have suggested that the so-called Hoosier personality[4] is unique to Indiana and that it may be partially responsible for possible cost effects attributed to the Indiana

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[4] According to Bauer and Clark, the Hoosier personality is defined by the New York Times Almanac as follows:

> Indiana's famous Hoosier personality was forged in the first half of the 19th century and its hallmarks were rustic simplicity, self sufficient isolation, and almost reflexive conservatism.

Program. That is, this thesis holds that the Hoosier personality may be a state exogenous factor varying systematically with the Indiana Program. For three reasons this seems unlikely. First, the effects of county socioeconomic characteristics are taken into account in the analyses.[5] Second, given the control hospitals used in this project, the socio-psychological climate of the study counties is probably similar in Indiana and the control states. Third, the Hoosier personality presumably did not change appreciably during the study years. At a minimum it would thus not account for an accelerating influence of the Program on hospital cost and other variables during the study period.

Thus, no state exogenous factors varying systematically with the Indiana Program rival it in terms of potential impact on hospital behavior. Accordingly, such factors do not cloud the interpretability of the Indiana Program Index.

Structure of the Regression Analyses

In terms of control group comparisons, this project has three types of regression analyses. The first, termed the Tristate analysis, compares Indiana and Tristate control hospitals. Its objective is to evaluate the Program in terms of a Type I environment. The second, termed the Michigan analysis, compares Indiana hospitals with Michigan control hospitals. Its purpose is to assess the Indiana Program in terms of a Type II environment.

The third, termed the Combined analysis, compares Indiana hospitals with all control hospitals. It is valuable from two viewpoints. First, the Combined findings can be employed to confirm the Michigan or Tristate results. Second, and more important, they provide the best summary findings when the Michigan and Tristate results are similar and/or when there is no substantive rationale to expect an appreciable difference between these results. The Combined findings are used extensively for this purpose in this report. In accord with this reliance on the Combined analyses, unless indicated otherwise, the study results described in this report are Combined findings.

From a time perspective this study has two types of regression analyses -- the annual and percentage change analyses. The former determines the Program's impact on cost and other variables in different study years. Using the 1973 cost analyses as an example, these analyses indicate the difference in total cost between Indiana and control hospitals in 1973.

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[5] As described in Chapter 8, a variable representing the political climate of study counties was included in preliminary analyses. Its influence was weak, however, and it was consequently deleted from the final analyses.

This difference represents the impact of the Indiana Program since four conditions are satisfied. First, as discussed in Chapter 10, based on the nature of the hospital industry and the characteristics of the Indiana Program, there is a sound substantive rationale for expecting the Program to influence hospital costs in 1973. Second, as described earlier, because of the conditions imposed on the selection of control states, there are no important state exogenous variables varying systematically with the Indiana Program.

Third, since regression analysis is employed in this study, the cost effects of other exogenous variables (and semi-exogenous variables) are taken into account. Fourth, for the reasons discussed earlier, it is remote that cost differences between Indiana and control hospitals predating the Program's implementation in 1960 are sufficiently large to account for significant cost differences between these hospitals in 1973. This point is confirmed by the time trend analyses described in Chapter 12.

The analogous four conditions hold for the total cost analyses in the other main study years. Accordingly, the cost differences between Indiana and control hospitals in these analyses are also due to the influence of the Indiana system.

The percentage change analyses determine the Program's impact on the percentage changes in cost and other variables between different study years. Most of these analyses examine the Program's influence between 1968 and 1973; others determine its effect between 1970 and 1973. Again using total cost as an example, the percentage change analyses show the difference between Indiana and control hospitals in terms of the percentage change in total cost between 1968 and 1973. This difference represents the impact of the Indiana system for reasons similar to the first three conditions discussed above for the annual analyses.

Structuring the analyses in this way, i.e., using the annual and percentage change analyses, has two substantial advantages. First, and most important, it is not necessary to impose special assumptions on the analyses. For example, there is no need to assume that the rate

of cost inflation is constant during the study years.[6] Second, the analysis findings are intuitively clear and directly useful. As an illustration, the results of the annual cost analyses can be easily converted into the Program's cost savings in each study year.

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[6] Both Cromwell et al. (1976a and 1976b) and Dowling et al. (1976a and 1976b) assumed that New York hospitals exhibited a constant annual rate of cost inflation before the institution of the New York program. Correspondingly, they assumed that while the New York inflation rate may have changed at the time of program implementation, it then remained constant again during the years after program implementation. Analogous assumptions were adopted for the control hospitals. Both studies then estimate the impact of the New York system by comparing these four inflation rates.

It may be necessary to use this methodologic approach in situations where there are strong reasons to expect that the experimental and control hospitals are fundamentally different, as appears to be the case for at least the Downstate New York hospitals. However, assuming that the annual rate of cost inflation is constant clearly strains reality, since in actuality cost inflation varies substantially from year to year. In addition, as discussed in Chapter 12, this approach is particularly worrisome in the Dowling study since the "before" inflation rates are based on only a single observation, i.e., the change between 1968 and 1969.

5.
Sample Selection

This chapter discusses the selection and characteristics of the hospital samples used in this study. This topic is central to any quantitative study, but is particularly important to this project for two reasons. First, data availability prevented a before/after comparison of Indiana and control hospitals. Second, data limitations necessitated the use of different samples for the three segments.

The chapter opens by considering the Indiana hospitals included in the main study sample -- the sample used in Segment I. Its next topic is the control hospitals which are in the main study sample. The chapter closes with a discussion of the Segment II and III samples.

Main Sample of Indiana Hospitals

The dominant focus of the Indiana Program is the nonfederal, short-term, general and related hospital. During the study years there were 110 such hospitals in Indiana. Since many exogenous/semi-exogenous variables affect total cost and other endogenous variables, it seemed advisable to include all these hospitals in the study. This conclusion was reinforced by the early realization that for two of the project data sources (the CPHA data base and the Project Survey) the penetration rate among study hospitals would not approach 100%.

However, two Indiana hospitals have unique characteristics. One specializes in proctology -- a field sufficiently uncommon to make selection of an appropriate control hospital difficult. The second is the Indiana University hospital. The analytical problem posed by this hospital is that the costs of university hospitals are heavily influenced by factors having little impact on the costs of nonuniversity hospitals. Further, university hospitals are outliers for many endogenous variables, including cost. As a result, such hospitals could unduly influence regression results.

These two hospitals were eliminated from the Indiana hospital universe, reducing that universe to 108 institutions all of which were invited to participate in this study. Thirteen hospitals, or 12% of the universe, declined to participate. Data for hospital costs or other major endogenous variables was incomplete for nine other hospitals, or 8% of the universe. The main study sample of Indiana hospitals thus consists of the remaining 86 institutions -- a sample sufficiently large to permit the application of regression techniques.

Although this sample includes 80% of the Indiana hospital universe, the possibility remains that it may be biased. Accordingly, it was necessary to compare the study Indiana hospitals and the non-study hospitals in the Indiana universe. Correlation analysis was used for this purpose. Comparability testing with this technique entails determining the correlations between a set of comparison variables (in this case, the special set described below) and an indicator variable denoting, in this instance, whether an Indiana universe hospital is or is not in the study.

Since complete data was unavailable for the non-study hospitals, it was impossible to compare those hospitals and the study hospitals in terms of the Segment I variables. However, it was feasible to compare these hospitals across a representative set of 26 variables created for this purpose from AHA Survey and Census data. The detailed comparison test results are shown in Appendix B.

In the comparison test there are only two significant differences between study and non-study hospitals: 1973 operations/admission and 1968 length of stay. Both differences are modest in magnitude. The highest correlation between either variable and the study/non-study indicator variable is .24, so that the degree of common variation between the latter and any comparison test variable is less than 6%. Further, there are no significant differences between the two sets of hospitals in terms of 1970 operations/admission or 1973 length of stay. The study and non-study hospitals are thus highly comparable.

The study sample was only partially self-selected. Almost as many hospitals were excluded for unavailability of data as for unwillingness to participate. Moreover, the lack of usable data was often beyond the hospital's control since it arose from logistical difficulties associated with the processing and storage of Medicare Cost Reports (the data source for cost and other variables).

The comparability test results, the absence of heavy self-selection, and the large size of the study sample (relative to the Indiana hospital universe) all point to the same conclusion: The study Indiana hospitals closely resemble the Indiana hospital universe. This conclusion clearly holds for the comparison test variables; it is likely that it is also true for a wider array of variables. The Segment I findings can therefore be generalized to the Indiana hospital universe.

Main Sample of Control Hospitals

As described in Chapter 3, the Michigan control hospital pool includes almost all hospitals in that state, and the Tristate pool consists of most hospitals in Illinois, Minnesota, and Iowa. Two general techniques can be used to select specific control hospitals from these pools. One is random selection in which hospitals are randomly chosen from the pools. The other is purposeful selection, which

entails two steps. The first is the specification of exogenous variables which may substantially influence hospital behavior. The second is the selection of control hospitals similar to Indiana hospitals in terms of such variables.

Neither sampling technique introduces a self-selection bias. Neither is contrary to the assumptions of regression analysis. Each has the objective of controlling for confounding factors. Although more expensive, purposeful selection will better achieve this objective than will random selection if two conditions prevail. First, the study substantive framework must be sufficiently developed to make it possible to specify the important exogenous variables (i.e., the confounding factors). Second, there must be a substantial likelihood that the experimental pool and the control pool(s) differ appreciably in terms of such variables.

As demonstrated by the discussions in Chapter 8, the first condition is satisfied in this study. The same is true for the second condition. While Indiana and Michigan are similar in some ways, they are different in others. For example, median family income is $9,966 in Indiana and $11,029 in Michigan. Similarly, 93% of the Indiana population is white and 65% is classified by the Census as urban. The corresponding statistics for Michigan are 88% and 74%. Analogous findings characterize the Tristate control pool.

Since these two conditions hold in this study, purposeful selection was used rather than random selection. It was implemented with a computerized matching procedure, which employed a multidimensional distance function and options permitting a tighter match on some variables than on others. With the exception of 1968 bed size (a semi-exogenous variable), only exogenous variables were employed as matching variables. In terms of these variables Tristate and Michigan hospitals were matched with Indiana hospitals on an individual hospital-by-hospital basis. As opposed to a group hospital matching technique, this procedure ensures not only that the means of the matching variables are similar for Indiana and control hospitals, but also that the variables' distributions are similar.

Using this matching procedure, 81 Tristate hospitals were selected as the Type I control group, and 79 Michigan hospitals were chosen as the Type II control group. The main study sample includes these hospitals and the 86 Indiana hospitals for a total of 246 institutions.

Collinearity involving the Indiana Program is uniformly low in the study analyses, as discussed in the next chapter. As a consequence, the ability of these analyses to separate the Program's impact from the effects of exogenous variables is enhanced. A major contributor to the Program's low collinearity is the purposeful selection technique. The use of this technique as opposed to random selection therefore strengthened the regression methodology.

Equally significant, as discussed in Chapter 12, the similarity between the Indiana and control hospitals substantially increases the validity of the time trend analyses. This similarity is the product of the control group selection process, which began with the specification of control states and concluded with the conduct of the matching procedure.

Samples for Segments II and III

The Project Survey is a major data source in Segment II; it is not employed in Segment I. Both segments rely heavily on Medicare Cost Reports (MCRs) as a data source, but in Segment II new variables requiring more detailed information are drawn from these reports. For these reasons, the Segment II sample is defined as those study hospitals meeting two conditions. First, they completed the capital usage and shared/contracted services questions on the Project Survey. Second, their MCRs contain sufficient information to permit the construction of the component cost variables. There are 144 such hospitals -- 55 Indiana hospitals, 50 Tristate hospitals, and 39 Michigan hospitals. Thus, 64% of the study Indiana hospitals are in Segment II; this statistic for all study hospitals is 59%.

Since the Segment II sample is thus appreciably smaller than the main study sample, the question arises as to whether the Segment II results can be generalized to the same degree as the Segment I findings. Three tests using correlation analysis were employed in response to this question. The first, termed Test A, compared Segment II Indiana hospitals with non-Segment II hospitals in the Indiana hospital universe. From a substantive viewpoint this is the most fundamental comparison, since it is directed toward the question: Did the selection of the Segment II sample introduce a systematic bias which precludes generalization of the Segment II findings to the Indiana hospital universe?

As noted earlier, only a circumscribed set of variables is available for this comparison. It is therefore important to conduct the second test, termed Test B, which compares Segment II Indiana hospitals with the remaining Indiana hospitals in the study. This comparison employs all the Segment I variables. Like the first test, its objective is to determine the degree of systematic bias in terms of Indiana hospitals. It specifically indicates whether the Segment II Indiana hospitals and the study Indiana hospitals resemble each other. By extension, it also indicates the degree of similarity between the Segment II Indiana hospitals and the Indiana hospital universe since it is highly likely that the study Indiana hospitals closely approximate that universe.

The third test, termed Test C, is based on the premise that the main study sample -- both control and Indiana hospitals -- is a highly appropriate group for assessing the impact of the Indiana Program. Supporting this premise is the Program's low collinearity in the Segment I analyses. This test compares all Segment II hospitals with the rest of the study hospitals.

The detailed findings of the three comparison tests are displayed in Appendix B. In Test C there is not a single significant difference in terms of the 56 Segment I variables. There are only four significant differences across the same variables in Test B. In Test A there is only one significant difference. As described earlier, in this same test there were two significant differences for the study hospitals. Hence, in terms of this test the Segment II and non-Segment II hospitals are even more comparable than are the study and non-study hospitals.

The common conclusion of these tests is that in terms of objective characteristics the Segment II sample is sufficiently grounded both in regard to the main study sample and the Indiana hospital universe. The only precautionary note is that the Segment II sample is self-selected, for it is largely framed by the Project Survey response rate. Even so, it is unlikely that a possible self-selection bias is sufficiently strong to offset the close comparability between the Segment II sample, and the main study sample and the Indiana hospital universe. Further, the Segment II sample includes more than 50% of the main study sample. Like the Segment I findings, the Segment II results can thus be generalized to the Indiana hospital universe.

The data source introduced in Segment III is the data base of the Commission on Professional and Hospital Activities (CPHA). Accordingly, the Segment III sample is defined as those study hospitals with CPHA data for both 1973 and 1970 (the years included in Segment III). Such a condition, i.e., requiring data for both years, was also imposed in the other segments, but is particularly important here because the CPHA penetration rate steadily increased during the study period. One hundred and four hospitals met this condition and are included in the Segment III sample: 32 Indiana hospitals, 42 Michigan institutions, and 30 Tristate hospitals. This sample thus includes 37% of study Indiana hospitals and 42% of all study institutions.

Comparability tests analogous to those used in Segment II were used to assess the appropriateness of the Segment III sample. Their detailed results are also shown in Appendix B. These tests indicate that there are more significant differences for the Segment III hospitals than for the Segment II institutions. This finding is not surprising since CPHA participation is generally skewed toward urban hospitals, larger hospitals, and nonprofit hospitals. However, none of the Segment III differences is large. The highest correlation between the Segment III/non-III indicator variable and a comparison variable is .29, which means that the degree of common variation between the indicator variable and any comparison variable is less than 9%. Further, some of the differences expected early in this project did not materialize, with the most prominent example being differences in bed size.

The length of stay findings are particularly critical since this variable is central to the Segment III analyses. In Tests A and C there are no significant differences in this variable, and in Test B the single difference is in 1973 length of stay -- a difference only narrowly significant at the .05 level. Another variable important to Segment III -- elderly caseload -- exhibits no significant differences in either Test B or Test C.

Like the Segment II sample, this sample is self-selected since it includes only hospitals voluntarily subscribing to CPHA services. However, it is unlikely that the circumstances influencing such participation in Indiana are substantially different from those influencing such participation in the control states. It is therefore improbable that self-selection introduces an important bias into the Segment III results.

On balance, Segment III includes a substantial minority of study hospitals, i.e., about 40% of such institutions. Self-selection bias is not an important consideration. Although there are more significant differences involving the Segment III sample than the Segment II sample, none are so large as to threaten the validity of the Segment III analyses. The main Segment III findings can therefore be generalized to the Indiana hospital universe.

6.
Analytical Techniques

This chapter discusses the analytical techniques used in the first three study segments. Regression analysis is the main focus. The strength of this type of analysis is that it takes into account other variables in determining the Program's impact. For example, the total cost regression analyses determine the Program's influence on hospital costs, taking into account the effects of exogenous variables, such as county income level. Because of this strength, regression analysis was used as this study's main analysis technique. With the exception of the time trend findings, all the Segment I-III results are derived from regression analysis.

The first chapter topic is the application of regression techniques. The chapter next discusses measures of quantitative impact, concentrating on the derivation of the percentage impact statistic for the Indiana Program. This chapter then considers collinearity and regression assumptions, pointing up important characteristics of the study regression equations. Correlation analysis is described next, followed by a discussion of variable construction. The last chapter section serves as a reference by defining the regression terms employed in this report.

Application of Regression Techniques

Development of the conceptual framework is the starting point for each segment's analyses. A crucial component of this framework is a series of hypotheses which are tested in the regression analyses. This approach is essential for two reasons. First, without it the results would be a maze of findings from which coherent and logical conclusions could not be constructed. Second, a conceptual framework is necessary to assess the substantive validity of individual findings. An example often cited in this regard is the positive correlation between lung cancer rates and telephone book sizes. Although somewhat whimsical, it nonetheless makes the point that statistical significance does not guarantee substantive validity.

In any study using quantitative techniques, the concept of statistical significance is a necessary evaluation criterion. It is mandatory to avoid reporting spurious results. If an effect is significant at only the .10 or .25 level, there is substantial likelihood that the effect is nonexistent. Consequently, the rule was imposed that all regression results described in this report as positive or negative must be significant at least at the .05 level.

This rule is in accord with customary practice in social science research, since the .05 level is widely used as the major cutoff point for statistical significance. In intuitive terms, significance at this level means that the probability of being wrong in interpreting the result as positive (or negative) is no higher than one in 20. Further, many of the more important study results are significant at the .01 or .001 levels. Significance at these levels denotes respectively that the chance of incorrectly interpreting the result as positive or negative does not exceed one in 100 or one in 1,000.

Exogenous and semi-exogenous variables must satisfy two conditions to be used as independent variables in specific analyses. First, the impact of the variable on the endogenous variable must be substantively logical. Second, this impact must be significant at least at the .05 level. These conditions share a similar rationale. On the one hand, it is erroneous to take into account the effects of substantively inappropriate variables: If phone book size does not impact hospital cost, it should not be included in the cost analyses. On the other hand, it is undesirable to take into account the effects of statistically insignificant variables because it cannot be shown with reasonable certainty that such effects are different from zero.

The generalized linear form of regression analysis is employed in this project. Within this general form, the two functional forms most frequently used in hospital analyses have been the linear form and the multiplicative (or "log-linear") form. No compelling conceptual logic supports the use in this study of one functional form as opposed to the other. On substantive grounds alone it is unclear whether the relationships examined in this project are primarily additive, as implied by the linear form; or mainly multiplicative, as implied by the log-linear form.

In this study the results obtained by using these two functional forms are similar. In particular, the predictive power of one form is not consistently greater than that of the other. This result is due largely to the high correlations between the untransformed variables and their respective logarithms. For example, in 1973 the correlation between total cost and its log is .94; that between average salary and its log is .99; and that between labor productivity and its log is .98. As further illustrations, the correlations between length of stay, ECF involvement, and medical education involvement and their respective logs are all .99; and that between income level and its log is .98.

In this study, neither functional form is thus superior to the other on substantive or statistical grounds. The linear form does have the major advantage of being intuitively clearer to policymakers and others not fully familiar with quantitative techniques. It was therefore selected as the functional form for this project.

The ordinary least squares (OLS) regression technique is entirely satisfactory for Steps A and B of the analyses, since endogenous variables are used only as dependent variables in these steps. In Step C it becomes necessary to use endogenous variables as independent variables because this step's purpose is to determine their effects on cost. It is thus appropriate to consider the use of simultaneous equation methods in Step C, particularly the two-stage least squares (2SLS) technique. This technique was employed in preliminary analyses; its findings were similar to those of the OLS technique. Consequently, since the 2SLS technique is more time-consuming and expensive than the OLS technique, the latter was employed for the Step C analyses as well as for the Step A and B analyses.

As discussed in Chapter 4, from a time perspective this study has two types of regression analyses. The annual analyses analyze endogenous variables in different study years; the percentage change analyses analyze the percentage change in endogenous variables between different years. For example, Segment II includes two years, 1968 and 1973. The segment's annual analyses are the 1968 and 1973 equations. Its percentage change analyses are the percentage change equations, with the percentage change being measured between 1968 and 1973.

Again from a time viewpoint, two types of exogenous/semi-exogenous variables are used in the annual analyses: variables measured in the same year as the endogenous variable; and variables measured in the only year for which data is available during the study period. Although annual values would be desirable for variables of the latter type, their absence is not seriously damaging since all are socio-economic factors, which usually change relatively slowly.

In the percentage change analyses three types of exogenous/semi-exogenous variables are employed. The first is percentage change variables calculated across the same years as the endogenous variable, i.e., the percentage change between the end years of the particular segment. The second is variables measured in the earliest year of the segment. The third is variables measured in the only year for which data is available during the study period.

The rationale for the first two types of variables is clear: Exogenous/semi-exogenous variables can affect endogenous variables either by changing during the study period or by establishing conditions at the beginning of the period which facilitate or impede change in the endogenous variable. The rationale for the third type is again necessity, but analytical concern about these variables is lessened by their slow rate of change and by the fact that most are measured in 1970 (being drawn from Census data).

Measures of Quantitative Impact

While statistical significance is a necessary evaluation criterion, it is not sufficient by itself. A highly significant relationship between a dependent variable and an independent variable does not necessarily imply that the latter has a strong impact on the former, even if the substantive basis for such an impact is sound. Statistical significance indicates that the relationship in all likelihood is non-zero; it does not assure that it is strong. For this reason it is important to use measures of quantitative impact.

All the endogenous variables are continuous. For such variables the best measure of quantitative impact is the elasticity coefficient. It equals the percentage change in the dependent variable produced by a unit percentage change in the independent variable. In this study the elasticity coefficient is specified as a percentage. For example, an elasticity coefficient of 30% indicates that a 10% change in the independent variable would produce a 3% change in the dependent variable.

The elasticity coefficient employed in this study is the elasticity at the mean of the independent variable. Defined in this way, it equals the regression coefficient of the independent variable multiplied by the ratio of the independent variable mean to the dependent variable mean, i.e., $B_i\bar{X}_i/\bar{Y}$ in regression terminology.

The elasticity coefficient is invariant to shift changes in percentages. To illustrate this point, if the elasticity coefficient is 33%, it indicates both that a 3% change in the independent variable would produce a 1% change in the dependent variable, and that a 15% change in the former would induce a 5% change in the latter. This assumption of constant elasticity is generally valid in a linear regression model for moderate changes in the independent variable, such as either 3% or 15%.

A major study objective is to determine the extent to which different endogenous variables transmit the Program's impact on cost. This transmitting effect is approximately equal to the Program's impact on the endogenous variable (as measured by the percentage impact statistic discussed later) multiplied by the endogenous variable's effect on cost as measured by its elasticity coefficient. Use of the elasticity coefficient in this way is appropriate only if the Program's impact on the endogenous variable is not extremely strong. Otherwise, the constant elasticity assumption would not necessarily be valid.

This potential difficulty does not arise in this study. In no instance does the Program's impact on an endogenous variable exceed the variable's standard deviation. The Program's influence is thus sufficiently moderate to allow use of the elasticity coefficient in calculating the transmitting effects of endogenous variables.

For dichotomous variables such as the Indiana Program Index, use of the elasticity coefficient as a measure of quantitative impact is neither theoretically nor intuitively valid. The degree of change contemplated for such variables is not a moderate change in the neighborhood of the mean, but rather a 100% change. That is, since the Indiana Program is either present or absent, it makes no sense to consider a 10% increase or decrease in the Program.

It was thus necessary to develop a measure of quantitative impact for the Indiana Program variable. This measure shows the Program's influence on the dependent variable in percentage terms. It is accordingly termed the percentage impact statistic of the Indiana Program. As an approximation, it indicates the percentage difference in the dependent variable between Indiana and control hospitals, taking into account the effects of exogenous variables. This difference is attributable to the Indiana Program, as discussed earlier. For example, assume that the 1973 total cost analyses show that the Program's percentage impact equals -5%. This finding means that the Program reduced hospital costs by 5% in 1973.

The percentage impact statistic is a modified elasticity coefficient which is defined as:

$$PI_I = \frac{B_I}{\bar{Y} - B_I \bar{X}_I} \quad ,$$

where PI_I = Percentage impact of Indiana Program

B_I = Regression coefficient of Indiana Program Index

$\bar{Y}$ = Mean of dependent variable

$\bar{X}_I$ = Mean of Indiana Program Index

The numerator of this statistic shows the predicted impact of the Indiana Program, i.e., the Program's regression coefficient multiplied by a value of (1) for the Indiana Program Index (indicating presence of the Program). The denominator is the predicted mean value of the dependent variable if all hospitals were not under the Indiana Program. It reflects the influence of exogenous variables, but is adjusted to remove the Program's effect.

In technical terms, this statistic indicates the Program's impact on the dependent variable relative to the average value of the dependent variable in the Program's absence. In more intuitive terms, it shows the Program's percentage impact on the variable, using as the baseline the situation that would prevail if the Program did not exist.

The percentage impact statistic thus shows the relative size of the Program's influence. Emphasis is accordingly placed on this statistic in discussing study results. It is equally important at times to discuss the absolute magnitude of the Program's impact.

Since the Indiana Program is represented by a dichotomous variable, the absolute magnitude of its influence is shown directly by its regression coefficient. If the dependent variable is measured in unfamiliar units (e.g., weighted skill mix units), the absolute size of the Program's effect is usually of little interest. The converse holds if the variable is measured in familiar units, such as dollars.

In this study the Program's absolute influence on a variable measured in dollars is defined as its dollar impact. This statistic is analogous to the percentage impact statistic. It indicates the dollar difference in the dependent variable between Indiana and control hospitals, taking into account the effects of exogenous variables. As an illustration, assume that the 1973 total cost analyses indicate that the Program's dollar impact is -$50. Since total cost is defined as cost per case (as described in Chapter 11), this result means that the Indiana Program lowered hospital costs by $50 per case in 1973.

Collinearity

The relationships among the independent variables in the regression equation are termed collinearity (or multicollinearity). Two statistics are employed to monitor collinearity. One is the covariance ratio of the independent variable, which indicates the degree of collinearity involving that variable. It equals the R^2 obtained by regressing the independent variable on the other independent variables in the equation, thereby showing the extent to which the latter predict the former. Like all R^2 statistics, the covariance ratio ranges from 0.0 to 1.0. As collinearity involving an independent variable rises, its covariance ratio increases.

The other collinearity measure is the determinant of the correlation matrix of the independent variables in the regression equation. While the covariance ratio is specific to each independent variable, the determinant characterizes the overall collinearity in the equation. Like the covariance ratio, the determinant ranges from 0.0 to 1.0, but it declines rather than increases as the degree of collinearity rises.

When collinearity involving a specific variable is severe, it is difficult to interpret the variable's effect. Regression analysis estimates the net effect of each independent variable, taking into account the effects of other independent variables. If a variable has a high covariance ratio, it is strongly related to at least one

other independent variable. While estimation of net effects is generally desirable, the net effect is likely to be too narrow a slice of the variable's total impact if collinearity is high. Accordingly, if the covariance ratio is higher than .80, difficulty will almost certainly be encountered in interpreting the variable's effect. If this statistic is between .60 and .80, the variable's effect is often interpretable but care must still be exercised.

Since this study's focus is the Indiana Program, it is essential to monitor the extent of its collinearity. If the Program's collinearity were high in some equations, the results would be questionable. However, collinearity involving the Indiana Program is uniformly low. In no instance is the Program's covariance ratio higher than .27; it is frequently less than .15. In many equations it is even below .05. Collinearity involving the Indiana Program thus does not interfere with the interpretability of the regression results.

The overall collinearity of the regression equations usually presents less of an analytic problem than does collinearity involving specific variables. This is especially true for this study with its emphasis on the Indiana Program's effects. Nonetheless, if overall collinearity is extremely high, the equation as a whole becomes difficult to interpret. For this reason substantial caution must be invoked in interpreting the results of an equation whose determinant is less than .01. Conversely, if the determinant is above .05, overall collinearity is seldom strong enough to warrant concern.

In this study overall collinearity is never excessive. The determinant is never below .10; it is often higher than .50. Consequently, like the Indiana Program's collinearity, overall collinearity does not represent an analytical problem in this project.

Three techniques contribute strongly to the modest collinearity in the regression results. One is the sample selection approach described in the previous chapter. Another is the variable construction process, whose main objective was to create the single best measure for each generic factor. The third technique is the exclusion of insignificant variables from the regression equations.

The first technique -- the sample selection approach -- is the most important in terms of decreasing collinearity involving the Indiana Program. It is thus the most crucial since the Program's collinearity is potentially the most troublesome. However, this technique's contribution to keeping overall collinearity modest is slight. Instead, the latter two techniques are primarily responsible for this. Together they result in the exclusion of substantively unnecessary and/or statistically insignificant variables from the regression equation.

Underlying Regression Assumptions

Regression analysis is based on several assumptions about the distribution of the residual term. One is that the residual term is normally distributed. If this assumption is violated, the probability estimates made by the regression equation are less accurate. A Kolmogorov-Smirnov test was used to test this assumption in 75 Segment I and III equations. In 87% of these equations the null hypothesis that the residual term is normally distributed cannot be rejected even at the .20 level. In another 6% of these equations the null hypothesis cannot be rejected at the .05 level. Therefore, the normal distribution assumption is satisfied in these equations, and by extension in the study equations generally.

A second assumption, termed the variance homogeneity assumption, is that the residual term's variance does not differ significantly for major components (i.e., subsamples) of the sample. For example, if an equation analyzes total cost, this assumption requires that it predict with equal accuracy the costs of hospitals involved in medical education (one subsample) and the costs of hospitals not so involved (the complementary subsample). If it predicts the costs equally well, the variances of these subsamples' residual terms will not differ significantly.

This assumption is especially relevant to this study in terms of the Indiana Program, for it is important that the analyses predict equally well the endogenous variables of Indiana and control hospitals. If this condition were not satisfied, it would suggest that important differences between Indiana and control hospitals were not represented in the analyses. Specifically, it would indicate that less reliance could be placed on the Indiana Program's regression coefficient and its percentage impact statistic -- two key statistics used in describing the study results.

The variance homogeneity assumption was tested in 14 Segment III equations. At the .05 level each equation predicts equally well the endogenous variables of Indiana and control hospitals. In all but one equation there is no difference in predictive accuracy even at the .10 level. The variance homogeneity assumption is thus sustained for the Indiana Program in these equations which span the Segment III analyses.

The variance homogeneity assumption was also tested for other independent variables in these equations. In 74% of the cases examined there are no significant differences in predictive accuracy at the .10 level. In another 9% of cases there are no significant differences at the .05 level. Only 3% of the cases exhibit differences in predictive accuracy significant at the .01 level. Hence, the variance homogeneity assumption is generally satisfied for other independent variables in these equations, although the conformance to this condition is not as great for these variables as for the Indiana Program.

These results strongly support the technical quality of the study equations. They indicate that solid confidence can be attached to the regression results. Particularly crucial are the findings demonstrating that the predictive accuracy of the regression analyses is equal for Indiana and control hospitals. This result makes it highly improbable that the Indiana and control hospitals are fundamentally different and/or that the analyses omit important variables which are markedly different for these sets of hospitals.

Correlation Analysis

Correlation analysis indicates the degree of association between two variables. Since correlation analysis is a close complement of regression analysis, the former was employed throughout the first three study segments to support the application of the latter. It was also heavily used in the variable construction process. While correlation analysis often yields valuable results, its findings must be regarded more cautiously than regression results because it does not take into account the effects of other important variables.

This study uses the ordinary product moment correlation coefficient. If this statistic is squared, it is converted to an R^2 statistic. For example, if the correlation between two variables is .30, the degree of common variation between them is $(.30)^2$, which equals .09 or 9%. In this example each variable accounts for 9% of the variation in the other.

In the early part of the study, profile analysis was used as well as correlation analysis. In each application the profile results closely resembled the correlation findings. It was thus unnecessary to use profile tests in the final analyses.

Central Principle of Variable Construction

This study encompasses a wide range of variable construction techniques, ranging from simple to complex. Similarly, it utilizes an array of data sources. Although diverse in detail, this study's variable construction is guided by a central principle -- a single measure, both substantively and statistically sound, should be used to represent each generic variable. For example, a single income measure should be used to represent income level.

The rationale for this principle is twofold. First, the use of substantively similar measures is confusing. As an example, an important issue for this study is not the Program's effects on 40 different process quality measures, but rather its overall impact on the quality of hospital care. Little but confusion is gained from comparing the Program's influence on quality measure 3 with its impact on quality measure 10, given that both measures are designed to represent the

quality of hospital care. The task is best accomplished by analyzing the Program's influence on an overall quality index based on the 40 individual measures.

Second, the inclusion of substantively similar and highly correlated measures in the same regression equation will sharply increase collinearity and make it difficult to interpret the results. Among others, a study by Berry (1974) illustrates this point. His hospital cost analyses include 40 different product mix variables, most of which are dichotomous measures indicating the presence or absence of a hospital service.

Among these variables are five dichotomous measures directed toward radiologic/nuclear medicine. The cost effects of the cobalt therapy and radioisotope measures are positive and significant at the .05 level; the impact of the diagnostic x-ray measure is positive but insignificant; and the effects of the therapeutic x-ray and radium therapy measures are negative but insignificant. From a substantive viewpoint it is difficult to argue, for example, that the radioisotope service increases hospital cost but that therapeutic x-ray and radium therapy do not.

Description of Regression Statistics

This section defines the regression terms used in this report. An outline format is employed so that this section can be more easily referenced.

Regression Model and Regression Equation -- The regression model indicates the "true" relationships between the dependent variable and the independent variables. It is written in the form shown below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon \ .$$

The regression equation is an estimate of the relationships in the regression model. Accordingly, the standard form of the regression equation is:

$$Y = B_0 + B_1 X_1 + B_2 X_2 + \cdots + B_p X_p + e \ .$$

Dependent Variable, Independent Variables, and Constant Term -- In both the regression model and the regression equation, Y is the dependent variable and the Xs are the independent variables. The constant term is B_0, which is an estimate of the constant β_0 in the regression model.

Regression Coefficients -- These statistics are the Bs ($B_1, B_2, \ldots, B_p$) in the regression equation which are estimates of the corresponding βs in the regression model. Each indicates the influence of the respective independent variable on the dependent variable. Unlike the elasticity coefficient the regression coefficients depend on

the units in which the dependent and independent variables are measured. Hence, standing alone they may be difficult to interpret on an intuitive basis.

However, for dichotomous variables like the Indiana Program, the regression coefficient indicates the variable's impact on the dependent variable in absolute terms. The Program's regression coefficient is thus intuitively clear if the dependent variable is measured in familiar units, such as dollars.

Expected Value of the Dependent Variable -- This statistic indicates for each hospital the value of the dependent variable that would be expected or predicted on the basis of the regression equation. This statistic is calculated in three steps. The first is to insert in the regression equation the hospital's values for the independent variables; the second is to multiply those values by the appropriate regression coefficients; and the third is to sum the resulting products and the constant term.

Residual Term -- The residual term is the difference between the actual and expected values of the dependent variable for each hospital. It is indicated by the term (e) in the regression equation, which is an estimate of the disturbance term (ε) in the regression model.

Elasticity Coefficient -- The elasticity coefficient of an independent variable is defined as the percentage change in the dependent variable produced by a percentage change in the independent variable. In this project the elasticity coefficient is stated as a percentage. It is the best measure of quantitative impact for continuous variables.[1]

Percentage Impact of the Indiana Program -- This statistic was created to indicate the Program's influence on endogenous variables in relative terms. It equals the ratio of the Program's regression coefficient to the adjusted mean of the dependent variable. The latter is defined as the dependent variable mean minus the product of the Program's regression coefficient and its mean. This statistic thus equals:

$$\frac{B_I}{\overline{Y} - B_I\overline{X}_I}$$

R^2 Statistic -- The R^2 statistic indicates the predictive power of the regression equation. It specifies the percentage of the variation in the dependent variable that is explainable in terms of the variations in the independent variables. It thus denotes the degree

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[1] The elasticity coefficient is described in more detail earlier in this chapter. The same is true for the percentage impact of the Indiana Program, the covariance ratio, and the determinant.

to which the independent variables explain or predict the dependent variable.

The R^2 statistic ranges from 0.0 to 1.0. As an example, if the R^2 of an equation is .60, the independent variables explain 60% of the variation in the dependent variable. Conversely, variables not included in the equation are responsible for the remaining 40% of the variation.

t-value -- This statistic indicates the probability that a regression coefficient is different from zero. Accordingly, a t-value is calculated for each independent variable in the regression equation.

Since directional hypotheses are attached to the independent variables in this study, it is appropriate to use a one-tailed rather than a two-tailed test. For example, if substantive considerations suggest that variable X_i will have a positive impact on total cost, the question is not simply whether its effect is significantly different from zero. Instead, it is whether its effect is significantly different from zero in a positive direction, since a negative impact will not be accepted on substantive grounds.

Covariance Ratio -- This statistic, which is calculated for each independent variable, indicates the extent of collinearity involving the variable.

Determinant -- This statistic is the determinant of the correlation matrix among the independent variables in the regression equation. It measures the degree of overall collinearity in the equation.

7.
Data Sources

The subject of this chapter is the principal data sources used in the first three study segments. The characteristics of these sources are important since they shape many study variables. Supplementary sources, identified in Chapter 9, were used for several exogenous variables.

This chapter first considers the Medicare Cost Reports (MCRs), the source for cost, productivity, and related variables. Its next topic is the data base of the Commission on Professional and Hospital Activities (CPHA), which is the source for the quality and case intensity variables. The AHA Survey, the next subject of this chapter, was not used as the main source for cost data, but was employed for the time trend analyses and the service mix variables. The following topic is Bureau of Census data, the source for the socioeconomic variables. The chapter closes by discussing the Project Survey, which was employed to fill the gaps between the other data sources as well as to generate information for Segment IV.

Medicare Cost Reports

From the outset it was clear that an extensive data source(s) was required for cost, productivity, and resource usage variables. Four sources were considered for this role: Medicare Cost Reports; AHA Survey; Hospital Administrative Services (HAS), a division of AHA; and Blue Cross data banks. The latter source was found to be unsatisfactory because it does not contain a sufficient range of variables for the control hospitals. HAS was also rejected as a data source in the early part of the study. Its dominant disadvantages are its incomplete penetration rates among study hospitals; its high processing cost; and the substantial coincidence between its scope and that of the MCRs.

The AHA Survey has a major comparative advantage over the MCRs in that its processing cost is much lower. The former is computerized while the latter are not. MCRs are complex documents containing a number of required pages and often a series of supplementary reports unique to each hospital. However, the scope of the MCRs is much broader than that of the AHA Survey in terms of the number of important endogenous variables that can be constructed from the source. Further, the MCRs are audited from an accounting standpoint, while the editing of AHA Survey data is largely limited to the identification of data processing errors.

Primarily because of their greater scope, the Medicare Cost Reports were selected as the main data source for the cost, productivity, and resource usage variables. They are also drawn upon for such variables as length of stay, bed size, and net worth. The MCRs are a principal data source in all three segments, but are especially important in Segments I and II. Although not employed as the main data source for the variables indicated above, the AHA Survey was used for supplementary purposes as well as for the time trend analyses and the service mix variables.

The MCRs proved to be a valuable data source, but rote coding is not an acceptable approach to obtaining information from them. Unlike many data sources, MCR data cannot be routinely transferred from a specific element on the MCR form to a coding sheet. Instead, the hospital must be considered as an entire institution. This entails comparing variables for each study year for consistency (e.g., beds, FTEs, cases, and costs for 1968) and cross-checking each variable across the study years.

Three factors necessitate the use of this more holistic approach, rather than a rote coding technique. First, MCRs are complex documents. Second, hospitals frequently submit reports unique to their institution, which either supplement or replace the standard MCR forms. Third, and most important, MCRs were designed for accounting purposes and are audited in terms of accounting, not research, objectives. The result of these factors is that although MCR data is satisfactory for research purposes, it is frequently not found in the same place in the MCR or presented in the same format.

CPHA Data Base

Unlike the cost and productivity areas, during the study period only one potential source existed for case intensity and quality data -- the CPHA data base. Other possible sources were limited in scope or confined to only a few hospitals. CPHA data was employed only in Segment III, but it is the source for most endogenous variables analyzed in that segment.

The central data gathering tool in the CPHA system is the Professional Activity Study (PAS) case abstract. Subscribing hospitals review patient records and complete these abstracts, i.e., one abstract per case. The abstracts are sent to CPHA which computerizes the data therein. The next step is CPHA's preparation of appropriate summary reports based upon this data, and the distribution of those reports to the subscribing hospitals. The summary reports do not contain in tabulated form all information available in the computerized data. Accordingly, there are two fundamental approaches to using CPHA data in a research study. One entails direct use of computerized CPHA data; the other involves utilization of the CPHA reports furnished to hospitals.

The major advantage of the latter approach is its low cost, but there are several important disadvantages as well. The Professional Activity Study (PAS) report is received by all hospitals subscribing to CPHA, but its scope in tabulated form is limited.[1] The diagnosis categories are broad (i.e., heterogeneous in terms of including diverse conditions in the same category) which makes construction of valid case intensity and quality indices difficult. Also, the number of information elements provided about each diagnosis group is relatively small which constrains the development of focused yet varied quality measures.

The same limitations apply to the Medical Audit Program (MAP) report offered by CPHA, although to a lesser extent. However, use of the MAP report suffers from another serious drawback: A substantial fraction of PAS subscribers are not MAP subscribers. Hence, reliance on existing MAP reports would sharply reduce the sample size.

Because of the disadvantages, and despite the higher cost, the alternative approach of using computerized CPHA data was adopted in this study. Diagnosis groups and the data elements for each group were specified by Spectrum Research; a program was developed by CPHA according to these specifications; and the program was applied to the CPHA data base for the appropriate hospitals and years. Aside from cost, the only limitation of this approach is that the desired data must be contained in the PAS case abstract -- a limitation which proved significant in the quality area. Even so, the use of this approach substantially strengthened the study methodology by making it possible to construct more accurate quality and case intensity indices.

The PAS case abstract remained essentially unchanged from 1970 through 1973, but this abstract and the organization of CPHA data files changed substantially between 1968 and 1970. Inclusion of both 1968 and 1973 in the case intensity and quality analyses would thus present difficulties. Data in the two years would not be entirely comparable, and the data processing costs would be much higher than if only 1970 and 1973 were included. Accordingly, 1968 was excluded and the years 1970 and 1973 were adopted for the case intensity/quality analyses.

Although by far the most widely available source for case intensity and quality data during the study years, CPHA's penetration among the

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[1] In addition to the summary tables, the PAS report contains an enumeration of all case abstract information. That is, CPHA returns to the hospital in paper form a copy of the hospital's raw data. While the raw data in this form could be used, it would be much more expensive than utilizing the same data in computerized form. Consequently, this approach was rejected early in the study and attention was focused on the two alternatives discussed above.

study hospitals was still incomplete. For this reason, only about 40% of the study hospitals are included in Segment III.

CPHA carefully checks its data for routine inconsistencies and data processing errors. Although the data abstractors at each hospital are specially trained by CPHA, their skills and persistence may differ to some extent across hospitals. Both the case intensity and quality indices rely on the final diagnoses recorded by physicians. If the recorded diagnosis differs from the physician's actual diagnosis, inaccuracy is introduced into this data. Analogous points apply to other data elements extracted from the patient's record. That is, the PAS case abstract cannot be more accurate than the patient's record.

Despite these potential difficulties, the basic quality of CPHA data is sound. It is likely that the case abstract strongly reflects the hospital record and that the patient's record is substantially correlated with his/her treatment and diagnosis. To increase the validity of variables drawn from CPHA data, individual data elements were evaluated in terms of potential error. On this basis a number of elements were eliminated from the variable construction process.

Equally important, there is no reason to suspect that CPHA inaccuracies are differentially distributed between Indiana and the control states. It is thus unlikely that possible inaccuracies distort the effects of the Indiana Program on the case intensity, quality or other indices drawn from this source.

AHA Survey

As discussed earlier, the AHA Survey was not used as the main source for the cost, productivity and related variables. It was employed for the time trend analyses, as described in Chapter 12. In addition, it contains data about the types of services offered by hospitals, while the Medicare Cost Reports and the CPHA data base do not. The AHA Survey was therefore used for the service mix variables.

The service mix analyses were included in Segment III for two reasons. First, they are substantively similar to the case intensity and quality analyses. Second, only 17 services were included in the 1968 AHA Survey, while the 1970 and 1973 surveys included 38 and 46 services respectively.[2] Further, there is a strong commonality between the

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[2] This specific difficulty illustrates the general problem of constructing comparable service mix indices across time using AHA Survey data -- a problem pointed up by Shuman, Wolfe, and Hardwick (1972).

1970 and 1973 services. As a result, in the service mix analyses it is far preferable to use 1970 and 1973 (the Segment III time points), rather than 1968 and 1973.

Since each service included in this survey is carefully described in the survey instructions, little definitional confusion should exist for repondents. There may be a tendency for respondents to inflate the number of services offered, but if so there is no reason to suspect that this propensity is higher or lower in Indiana hospitals than in the control hospitals.

Bureau of Census Data

The most comprehensive source for socioeconomic variables is Bureau of Census data, which was consequently used in this study. Census data has a number of strong points. Its scope is broad; its validity is high; there are no missing data problems; it is available for all study counties; the cost of using such data is low; and it is accessible to the public.

This data source does have a major drawback. The majority of Census variables, and all such variables used in this study, are available for only a single year in each decade, usually the first.[3] Consequently, measures showing the percentage change between study years cannot be calculated for Census variables. Similarly, only a single value for each Census variable can be used in the analyses. For example, the same white population variable (measured in 1970) is used in the 1973, 1970, 1968, and percentage change cost analyses. However, as discussed in Chapter 6, this weakness is not severe since most Census variables change slowly and are based on 1970, the middle of the study period.

Project Survey

The general purpose of the Project Survey was to secure data not available from secondary sources. Within this purpose were three specific objectives. The first was to obtain data for the labor usage, capital usage, and shared/contracted services variables used in Segment II. The second was to secure information about hospital staff characteristics, which is used in Segment IV. The third was to generate data for supplementary or confirmatory purposes. For example, Survey data for medical education involvement was used to confirm AMA data for this variable, and the Survey was the source for the nursing and other education variables used in preliminary analyses.

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[3] County population is an exception to this point. However, it is not used directly in the analyses, but rather is employed to construct population-based variables such as physician concentration.

The Project Survey was mailed to study hospitals and follow-up telephone calls were employed to encourage hospital response. The Survey was pretested by eight hospitals, which proved valuable since several questions were modified as a result. The Survey data was thoroughly reviewed by the project team. If a hospital's response to an important question was unclear, improbable, or inconsistent, a telephone discussion was held with the hospital to clarify the response. The validity of the Survey data is thus sound.

8. Substantive Basis of Exogenous and Semi-Exogenous Variables

This chapter is an important element in the study substantive framework. It identifies and discusses the factors whose effects must be taken into account in assessing the Indiana Program's impact on cost and other endogenous variables. Exogenous and semi-exogenous variables are defined in Chapter 4. The model developed in that chapter indicates the role played by these variables in this study.

State exogenous variables are discussed in Chapter 4. This chapter's sections address sequentially three related generic types of variables: hospital exogenous variables, local exogenous variables, and semi-exogenous variables. Each section discusses the analytical problems posed by each generic type of variable. Each then considers specific variables within each generic type and reviews the substantive rationale mandating their inclusion or permitting their exclusion. The measures used to represent the included variables are described in Chapter 9.

Hospital Exogenous Variables

An exogenous variable of this type characterizes individual hospitals. Since the hospital is the unit of analysis in this study, the influence of such variables is easily taken into account by including them as independent variables in the analyses -- an approach not possible with state variables.

Because the hospital is the target of the Indiana Program, it is theoretically possible for any hospital characteristic to be influenced by the Program, i.e., to be an endogenous, rather than exogenous, variable. For such characteristics the prime analytical issue is thus the likelihood that each characteristic is exogenous (or semi-exogenous) as opposed to endogenous.

The duration of a prospective rate setting program exerts a major influence on this likelihood. The longer the program has been in effect, the greater is the likelihood that hospital characteristics will be endogenous. Nonetheless, certain hospital characteristics, such as type of hospital control, will remain exogenous (except in rare instances) regardless of the program's duration. In contrast, assuming that the program has operated for at least a short period of time (perhaps one year), other hospital characteristics are universally endogenous, e.g., hospital costs.

Between these two extremes a substantial number of characteristics are initially exogenous, but become endogenous over time. An example is hospital service mix. During the first year of a prospective rate setting program, service mix is largely exogenous. By the fifth year of the program, or certainly by its tenth year, service mix is endogenous because it is by then within the potential influence of the program.

Since the Indiana Program was implemented in 1960, most hospital characteristics are endogenous variables during the main study period of 1968 through 1973, but there are a few important exceptions. One of these was mentioned above -- hospital control type (nonprofit, local government, etc.). It is extremely unlikely that a hospital would change its control type because of the pressures or incentives of a prospective rate setting program. The only way such an effect seems possible is if the program severely weakens the financial position of hospitals. This is unlikely in the case of the Indiana Program.

Especially in the context of this study, in which there are virtually no for-profit hospitals, hospital control is unlikely to have a major impact on hospital costs, although such an effect is possible. Other endogenous variables, such as financial position, resource usage, and service mix, may be substantially influenced by hospital control. Thus, hospital control meets the other part of the definition of an exogenous variable. Not only is it extremely unlikely that the Indiana Program influences hospital control, but there is a significant probability that hospital control impacts endogenous variables.

Like organizations in other industries, hospitals utilize different twelve-month periods or fiscal years for reporting financial data. The two most common fiscal years used by study hospitals are the calendar year, and the year beginning July 1st and ending the succeeding June 30th. There is thus a six-month difference in the financial reporting period among some study hospitals and a larger difference among other study hospitals.

Fiscal year differences will have little impact on those endogenous variables which are changing slowly over time. However, in the hospital sector many endogenous variables changed rapidly during the study period. The most important of these is hospital costs, but other variables also changed dramatically, such as average salary and capital intensity.

The hospital fiscal year may be affected by a prospective rate setting program. For example, the program could mandate that one quarter of participating hospitals use the calendar fiscal year, one quarter employ the fiscal year ending in March, etc. However, the Indiana Program

has made no effort in this direction.[1] It is therefore appropriate to treat fiscal year as an exogenous variable.

Hospital medical education involvement is likely to have a major impact on hospital performance. It is expected not only to exert a strong positive influence on hospital cost, but also to have an effect on other endogenous variables such as service mix and productivity.

Participation in medical education programs is largely determined by the hospital's physician staff and in many instances by the faculty members of medical schools with which the hospital is affiliated. As discussed, physicians are largely outside the influence of the Indiana Program. For this reason alone, it seems improbable that the Indiana system has significantly affected hospital involvement in medical education.

Further, unless financial pressure exerted by a prospective rate setting program is extremely strong, hospital administrators and board members will be loath to alter the nature of their medical education programs. One of the most important factors determining hospital prestige, and the consequent ability to attract physicians, is the nature of the hospital's medical education program. Such programs are likely to be among the last trimmed in response to financial pressure. Equally important, the Indiana Program has made no effort either explicitly or implicitly to reduce hospital involvement in medical education. Such involvement is considered by the Program in setting hospital rates.

Since these circumstances make it extremely unlikely that the Indiana Program has modified hospital involvement in medical education, this variable is considered an exogenous factor in this study.

This same paradigm does not necessarily hold for other hospital-sponsored education programs, such as nursing education or ancillary personnel training. Such programs could be affected by a prospective rate setting program. However, the Indiana Program takes a favorable stance on hospital involvement in nursing and other education. It recognizes not only the patient care costs of education programs, but also their net teaching and administrative costs.

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[1] Even if this were not the case, it is essential to separate the effects of differing fiscal years from the impact of a prospective rate setting program. This must be done because the impact of fiscal year on hospital costs is artificial; it is simply the result of measuring hospital costs (or other endogenous variables) across different time periods. Hence, if a prospective rate setting program has altered hospital fiscal years, this factor should still not be treated as an endogenous variable. Instead, in this instance it should be considered a semi-exogenous variable.

The only requirement is that the education program be approved by the Indiana Program. To meet this provision a program need only satisfy two relatively easy criteria. The first is that in general terms the program must be designed to enhance the quality and/or efficiency of health care delivery; and the second is that the program must be licensed by the state or approved by the appropriate professional organization.

It is thus unlikely that the Indiana Program affects hospital involvement in nursing or other education. Further, unlike medical education involvement, neither nursing education involvement nor other education involvement had a significant influence on cost in preliminary analyses. Accordingly, both variables were excluded from the final analyses.

Local Exogenous Variables

The environment in which a hospital is located is likely to have a major influence on hospital performance. It is probable that it plays an important role in determining both the demand for hospital care and the supply of such care. In terms of the latter, it is likely to influence primarily the supply of inputs to the hospital, but also at times the techniques used to produce patient care.

In characterizing a hospital's local environment the most appropriate unit is the hospital market area, i.e., that area predominantly served by a hospital or set of hospitals. In some instances the hospital market area may be a county; in others a multi-county region; and in still others a sub-county area. Since data indicating the geographic origin of hospital patients was not available across the study states, it was impossible to delineate market areas for the hospitals in this study. Among the geographic units for which data was available, the county of hospital location was accepted as the unit most closely approximating the hospital market area.[2]

Many factors characterize the county of hospital location, but only a few would be expected to impact hospitals in a significant and predictable way. Although there are exceptions, the possibility that a local variable is endogenous rather than exogenous is of much less analytical concern. Hence, in this section emphasis is placed on the probability that a variable influences hospitals, rather than on the likelihood that the Indiana Program impacts the variable.

Physicians are the key decision makers in most health care matters, including hospital care. Not only do they have substantial influence on hospital operations as a whole, but their impact is predominant

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[2] This approach has been taken by most hospital analysts, including Salkever (1972), Davis (1974), and Pauly and Drake (1970).

in certain areas of hospital performance, especially case intensity, utilization, and quality. Physician concentration in the county of hospital location is thus likely to exert an important influence on hospital performance. Since the physician is relatively distant from the Indiana Program, the possibility is remote that this Program has significantly influenced physician concentration, and such concentration will be considered an exogenous factor throughout this study.

The mixture of physicians in the county of hospital location may also be important. Among others, Bauer and Clark (1974) suggest that the relatively high prevalence of general practitioners in Indiana may be partially instrumental in reducing hospital costs in this state. Further, it is not redundant to include general practitioner concentration since it is expected to have only a modest correlation with physician concentration.[3] Accordingly, this variable is considered an exogenous variable with the general expectation that its influence will be the reverse of physician concentration.[4]

The characteristics of hospitals in proximity to each study hospital may exert an important influence on the latter. However, such characteristics are endogenous, rather than exogenous, to the Indiana Program. That is, the Program (or a control state payment/planning program) affects not only the immediate study hospital, but also the hospitals in proximity to it. Hence, the characteristics of the latter are not exogenous variables and are accordingly excluded from this study.

Each of three sectors consumes between 5% and 10% of total health care expenditures -- drugs, dental services, and nursing home care. The former two sectors are relatively remote from hospital care, but the concentration of nursing home beds could exert a significant influence on selected areas of hospital performance. However, this factor could be affected by the Indiana Program -- not because of the Program's direct impact on the nursing home industry, but rather because of possible secondary effects arising from the Program's influence on the hospital sector. Even so, nursing home bed concentration was included in preliminary analyses. Its effects were generally insignificant, and it was eliminated from the final analyses.

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[3] In contrast, it is unnecessary to include primary care physician concentration or surgical specialist concentration since both are strongly correlated with physician concentration.

[4] While osteopath concentration was not expected to have a major impact on hospital performance, it was included in preliminary analyses. However, its influence was weak and it was deleted from the final analyses.

One of the major factors affecting the demand for hospital services is the pervasiveness of insurance coverage for such services. Insurance coverage reduces the effective price of hospital services to the consumer and thus increases the demand for hospital care.

The major public hospital insurance programs are the Medicare and Medicaid programs. As large as these programs are, they still cover only 35% to 40% of hospital expenditures. In contrast, 50% to 60% of such expenditures are covered by private health insurance. The breadth and depth of private insurance coverage is thus likely to have a major impact on the demand for hospital care.

Although there are no reliable statistics indicating the extent of private health insurance coverage at the county level, such statistics are available at the state level. Utilizing an approach analogous to those used by Chiswick (1976) and O'Donoghue et al. (1976), a regression equation was developed which predicted the extent of private insurance coverage at the state level in terms of the prevalence of occupational and industrial groups. This equation was applied to county data to develop an index estimating the extent of private insurance coverage in each study county.

This index is intended to reflect the extent of hospital insurance coverage in the study counties. As an approximation of such coverage, it may be relatively gross; its effect may thus be only partially representative of the "true" impact of private insurance coverage. Because of its substantive and statistical soundness, however, and because of the successful use of analogous indices in other studies, this index is included in this study. It is considered an exogenous variable since the Indiana Program probably does not have an appreciable impact on the extent of private insurance coverage.

Both the demand for and supply of hospital care are substantially influenced by the socioeconomic and demographic characteristics of the county population. One of the most important characteristics is county income level, which is expected to have a positive impact on hospital cost as well as sizeable effects on other endogenous variables. This variable is a proxy for general wage levels in the community, which exert a strong influence on hospital wage rates. Further, income level partially reflects the prices of certain other inputs used by hospitals (e.g., accounting fees and construction costs), although other input prices are largely independent of this factor (e.g., drug and medical supply prices).

In addition to its effect on supply, income level influences the demand for hospital care for two reasons. First, given the strong correlation between income level and the socioeconomic status of the county, income level impacts to some extent both the mixture of diseases and the pattern of hospital care consumption (independent of different disease mixes).

Second, income level indicates the ability of consumers to pay for hospital care. Although this factor is now less important because of the pervasiveness of hospital insurance coverage even in rural areas, there is a strong positive relationship between private insurance coverage and income level. Since private insurance coverage is represented in this study by an index which is only an approximation of such coverage, income level may also be partially reflective of the degree of private insurance coverage.

Income level is an exogenous variable since it is exceedingly remote that it has been affected by the Indiana Program. This same point applies to the other socioeconomic and demographic characteristics discussed in this section.

Independent of income level, the urban/rural character of study counties may influence hospital performance. The impact of this county characteristic is expected to be generally less than that of income level, especially since the concentration of physicians is also included as an exogenous factor. However, the extent of urbanization may affect both disease mixture and hospital care consumption patterns. In particular, rural hospitals may provide primarily short-term acute and convalescent care, with the aged being the predominant recipients of the latter. Hence, urbanization may influence hospital patient mix, quality, and service mix. In addition, this factor may influence the supply of hospital care both by impacting production techniques and by affecting the prices of capital inputs.

The major racial dimension of the five Midwestern study states is that between whites and blacks. Accordingly, county white population may have an important impact on the demand for hospital care. While there are strong similarities in the disease patterns of whites and blacks, there are also significant differences. Moreover, whites and blacks may exhibit different patterns of hospital care consumption (although this point is less definitively established). White population may thus have significant effects on such demand-related variables as case intensity and service mix. Acting in part through these variables, it may have an appreciable influence on cost, productivity, and resource usage.

A strong positive relationship between county education level and county income level is expected in this study. As a consequence, in the regression analyses many of the anticipated bivariate relationships between education level and hospital performance variables are likely to be overridden by the stronger income variable. Such an outcome is especially likely for the impact of education level on the supply of hospital care. Education level may nevertheless affect some aspects of the demand for hospital care more strongly than does income level. This may be true in terms of both disease mixture and hospital care consumption patterns. Education level is thus included, although its effects are not expected to be as great as those of income level.

The age profile of the county population has a substantial effect on the demand for hospital care. The very young and the old exhibit disease patterns strikingly different from those of the remainder of the population. The latter group and the measures that represent it are discussed later in this chapter.

County pediatric population, representing the former age group, substantially influences the demand for pediatric care, and by extension, the demand for obstetric care. These two types of care have a number of common characteristics, including short lengths of stay; a high level of ancillary service intensity per patient day, but not per case; and substantial, largely unpredictable fluctuations in demand. As a consequence, pediatric population may influence both case mix and other hospital performance variables.

Another characteristic of the local environment which may significantly affect hospital performance is the county population growth rate. This factor was accordingly included in preliminary analyses, but its effects were generally insignificant. It was therefore not retained in the final analyses. A similar finding was obtained for county female population whose variation across the study counties is very low. In addition, a variable designed to partially represent the political climate of the study counties[5] was included in preliminary analyses, but like the previous two variables, its effects were weak and it was removed from the final analyses.

Semi-Exogenous Variables

These variables are akin to exogenous variables in that they are expected to affect hospital cost and/or other endogenous variables. They differ from exogenous variables in terms of the link between the variable and the Indiana Program. In order to be exogenous, it must be highly improbable that the variable is influenced by the Program. In contrast, the relationship between a semi-exogenous variable and the Program is less straightforward. There are two types of semi-exogenous variables in terms of this characteristic.

One type, termed Type A, is defined as those variables for which there is a significant possibility that the Indiana Program, or a control state hospital payment/planning program, affects the variable. However, substantive reasons mandate isolation of the cost effects of such variables from the cost impact of the Indiana system.

The other type, termed Type B, is defined as those variables having three characteristics. First, it is unlikely that the Indiana Program

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[5] This variable was defined as the percentage of county votes cast for the Republican candidate in the 1968 Presidential election.

affects the variable. Second, such an effect is still sufficiently plausible that the variable cannot be considered an exogenous variable. Third, because of data availability, factors closely related to the variable cannot be analyzed until Segment II or III.

Such variables pose a dilemma. On the one hand, it is inappropriate to consider them endogenous throughout the study since it is unlikely that they are influenced by the Program. On the other hand, it is inadvisable to prematurely analyze them in Segment I. To illustrate this point, consider length of stay. It is strongly advantageous to analyze length of stay in Segment III rather than in Segment I or II, since the variables determining length of stay -- case intensity, patient mix, and utilization practices -- can also be analyzed in Segment III. Analyzing all these variables in the same segment enables sounder inferences to be drawn about the causal linkages between the Indiana Program and length of stay.

To resolve this dilemma, variables of this type (with one exception discussed later) are considered semi-exogenous in Segment I and are analyzed as endogenous variables in Segment II or III. Accordingly, these variables are discussed here, but are also addressed in later chapters describing the Segment II or III results.

There are two Type A semi-exogenous variables, both of which are hospital characteristics. One is extended care facility (ECF) involvement, i.e., the extent of involvement by the hospital in ECF care. The other is emergency/outpatient involvement, i.e., the degree of involvement by the hospital in outpatient and emergency care.

Data limitations made it impossible to accurately separate the costs of ECF care and emergency/outpatient care from the costs of acute inpatient care. The former costs are thus included in total hospital expenses, i.e., the numerator of the total cost variable. Conversely, neither ECF nor emergency/outpatient utilization are included in the denominator of the total cost variable, i.e., acute hospital cases.[6] It is thus likely that these two variables have a positive impact on total cost and that they influence other endogenous variables, such as labor productivity and capital intensity.

The Indiana Program has remained essentially neutral regarding hospital ECF and emergency/outpatient involvement. In contrast, during the main study period Michigan Blue Cross allowed hospitals a community

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[6] This approach was adopted because equivalencies in terms of cost implications have not been established for acute inpatient care, ECF care, and emergency/outpatient care. For example, no major study (using a large number of hospitals and quantitative techniques) has established that the costs of one acute hospital case approximate those of X number of emergency room and outpatient visits.

improvement factor, equalling 2% of costs for inpatient care and 6% of costs for outpatient care. Outpatient expenses were also excluded from the cost ceiling regulations imposed by Michigan Blue Cross. It is consequently probable that Michigan hospitals were more involved in ambulatory and emergency care than were Indiana hospitals. If so, their costs would have been higher as a result.

It is not the general objective of prospective rate setting programs to decrease hospital emergency/outpatient involvement. It is thus necessary to separate this anticipated effect of the Michigan program from the expected cost impact of the Indiana Program. The Indiana Program should not be given credit for decreasing hospital costs to the extent that such decreases arose from higher emergency/outpatient involvement in Michigan.

A similar paradigm applies to hospital ECF involvement. The Program's effects on cost and other endogenous variables should stand free from possible differences in ECF involvement between Indiana and control hospitals. The Indiana Program should neither benefit from nor be penalized for cost differences resulting from differential involvement in ECF care by Indiana and control hospitals.

There are three Type B semi-exogenous variables; all are hospital characteristics. One is length of stay, which for two reasons is expected to have a powerful positive impact on total cost (which is defined as cost/case). First, the longer the length of stay for any reason, the higher will be total cost, since cost/day remains positive throughout the hospital stay, although it declines during the convalescent stage of illness. Second, length of stay is frequently long because of more complex case mix and higher case severity. To the extent this is true, cost will be higher because more ancillary, nursing, and other services will be required to treat the patient.

As discussed in Chapter 18, it is unlikely that the Indiana Program has a significant influence on length of stay. The underlying rationale is twofold. First, physicians are largely unaffected by the Indiana Program. Second, physicians primarily determine case intensity and other elements influencing length of stay. Accordingly, length of stay is considered a Type B semi-exogenous variable in Segments I and II. It is then treated as an endogenous variable in Segment III, and the Program's influence on this variable is assessed.

An important patient mix variable is the hospital's elderly caseload, i.e., the proportion of its patients who are at least 65 years of age. The disease mixture of the elderly is different from that of the remainder of the population. On the one hand, the aged frequently have more extensive and life-threatening conditions; on the other hand, their illnesses are often chronic but characterized by episodic acute exacerbations. As a result, the relationship between elderly caseload, and case mix and case severity is not clear-cut. A large elderly caseload may indicate high case severity and case mix if the hospital

is primarily providing definitive care to the aged. If the hospital is mainly providing symptomatic or convalescent care to the elderly, a high elderly caseload may be indicative of low case severity and case mix.

Since the inception of the Medicare program, the elderly have been almost entirely covered for hospital expenses. This has decreased the financial constraints on the aged's consumption of both complex and symptomatic hospital care. That is, institution of the Medicare program increased the demand for both types of care.

The provision of definitive care to the elderly is likely to entail long lengths of stay. Similarly, provision of convalescent care to the aged after an acute episode of illness is often accompanied by a long length of stay. In contrast, treatment of an acute illness of moderate severity (e.g., some types of gastrointestinal disease) is likely to involve a relatively short length of stay. Even so, for most illnesses the length of stay of the aged is longer than that of the general population. The longer time period required by the elderly for convalescence and the greater severity of their illnesses override the tendency by physicians to admit the aged more frequently than the younger adult population for short-term acute treatment.[7]

Primarily because of this length of stay effect, elderly caseload is expected to have a positive impact on total cost. However, if the effect of length of stay is taken into account, elderly caseload is likely to have an insignificant or even negative effect on cost. Further, elderly caseload may have a sizeable impact on other endogenous variables, such as resource usage and financial position. It is thus necessary to include elderly caseload in this study because of its potential effects on both cost and other endogenous variables.

For reasons analogous to those for length of stay, it is unlikely that the Indiana Program induces hospitals to modify their concentration on treatment of the aged. Hence, elderly caseload is considered a Type B semi-exogenous variable in Segments I and II. As with length of stay, the Program's possible impact on elderly caseload is analyzed in Segment III, i.e., this variable is treated as an endogenous variable in that segment. Accordingly, county elderly population is included in Segment III as a local exogenous variable. Despite the fact that it is clearly exogenous to the hospital, this factor is not used in Segments I and II since it is less hospital-specific than elderly caseload.

There is usually a strong positive association between bed size and total cost. That is, large hospitals tend to have higher costs and

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[7] For example, CPHA (1974) reports that median length of stay for pneumonia is 11 days for the aged and seven days for individuals aged 20 to 49 years.

small hospitals tend to have lower costs. However, this positive relationship frequently disappears when the effects of other factors are taken into account through regression analysis.[8] The rationale for this apparent paradox is that larger hospitals usually have characteristics which produce higher cost, but size alone is not cost-increasing. For example, larger hospitals are disproportionately involved in medical education programs, and such involvement is expected to have a strong positive impact on cost.

Hence, in the study regression analyses the influence of bed size on cost will probably be modest or insignificant -- certainly weaker than is at times presumed by policymakers, hospital administrators, and others. However, bed size may have a substantial influence on other endogenous variables, such as service mix, patient mix, and resource usage. It is thus essential to include this variable.

Five to ten years frequently elapse between the initial planning of hospital expansion and the operational use of the new facilities.[9] Bed size can be reduced more rapidly, but hospital administrators and board members, physicians, and community leaders are general reluctant to institute a major closure of hospital facilities. Hence, while minor adjustments in bed size can be made relatively quickly by the hospital, large changes in bed capacity occur only over a long time period. It is thus likely that in the earliest study year -- 1968, eight years after the inception of the Indiana Program -- bed size is still exogenous to the Program. It is hence appropriate to consider bed size a Type B semi-exogenous factor in that year.

Because of this factor's importance as a hospital structural characteristic, 1968 bed size was used as a matching variable in the sample selection process. As a consequence, possible differences in bed size between Indiana and control hospitals were reduced, thereby facilitating the interpretability of the analyses directed toward other variables.

Despite the overall strength of this approach, it has the limitation that it renders invalid an analysis of the Program's impact on 1968 bed size across the study hospitals. That is, unlike length of stay and elderly caseload, it is not possible to test the hypothesis that

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[8] Studies illustrating these points are Davis (1974) and O'Donoghue, Gatch, and Hoffman (1977).

[9] The General Accounting Office (1972) found that the average length of the pre-construction planning period for hospital facilities was 6.5 years. It is likely that the construction period consumes at least 18 months to two years. Therefore, on average, eight or more years pass between the initial planning of new hospital facilities and the completion of those facilities.

led to the classification of 1968 bed size as a Type B semi-exogenous variable. However, the substantive rationale responsible for that classification -- the long lag period associated with changes in bed size -- is stronger than that for either length of stay or elderly caseload.

The change in bed size between 1968 and 1973 is small relative to 1968 bed size. It was therefore anticipated that it might be necessary to consider 1973 bed size a semi-exogenous variable because of its expected strong positive relationship with 1968 bed size. This expectation was realized; the correlation between 1968 and 1973 bed sizes is very high, .98. Hence, 1973 bed size must be treated as a semi-exogenous variable, as must bed size in 1970 and 1972.

In contrast, the percentage change in bed size between 1968 and 1973 is potentially endogenous to the Indiana Program. It is considered a semi-exogenous variable in Segment I, but is included as an endogenous variable in the capital usage analyses of Segment II. Although not analyzed specifically, it is also treated as an endogenous variable in Segment III.

9. Construction of Exogenous and Semi-Exogenous Variables

The purpose of this chapter is to describe the construction and properties of the variables used in the analyses to represent exogenous and semi-exogenous factors. After describing the Indiana Program Index, the chapter discusses the hospital and local exogenous variables and then the semi-exogenous variables. A summary table specifying these variables concludes this chapter.

Important correlations among these variables are discussed in this chapter. As a reference, Appendix B contains all such correlations in 1973 as well as the correlations among the percentage changes in these variables. This appendix contains these correlations for each of Segments I, II, and III.

Appendix B also displays the means and standard deviations of these variables in 1973 and 1968, as well as these statistics for the percentage changes in these variables. Again, these statistics are shown for the Segment I, II, and III samples.

Indiana Program Index

In this study the Indiana Program is represented by a dichotomous variable, in which (1) indicates an Indiana hospital and (0) a control hospital. The low collinearity of this index in the regression analyses is discussed in Chapter 6. Its correlations with exogenous and semi-exogenous variables are displayed in Appendix B.

Hospital Exogenous Variables

Type of Control

Less than 1% of the study hospitals are for-profit institutions. The primary division in hospital control type is therefore that between nonprofit private and local government control. A dichotomous variable is used to represent this difference, with (1) indicating nonprofit control and (0) all other types of control.

Approximately 60% of study hospitals are private nonprofit institutions. About one third of these hospitals, or about 20% of total study hospitals, are church operated, while the remainder are nonchurch affiliated. Since this distinction may have an important influence on some endogenous variables, a second dichotomous hospital control measure was created, with (1) representing church control and (0) all

other types of control. As expected, the correlation between nonprofit control and church control is significantly positive, but not extremely high, equalling .37 in 1973.

As anticipated, the pattern of hospital control remained relatively constant during the study years. There was, however, a small decline in the extent of church control and a modest increase in overall nonprofit control, i.e., a movement toward nonprofit nonchurch control from both church and local government control.

Fiscal Year

The most frequent hospital reporting period is the calendar year. The year beginning July 1st and ending June 30th is the next most common hospital reporting period, but some study institutions utilize other fiscal years.

In creating the fiscal year variable, June of each study year was selected as the base. The variable was then calculated as the number of months between the June base and the end of the hospital's reporting period. For example, if a hospital uses the calendar year as its reporting period, its value for the fiscal year variable is 6. If a hospital's reporting period ends in September or June, its fiscal year variable equals respectively 3 or 12.

Since fiscal year could also influence endogenous variables if hospitals changed their fiscal year during the study period, a second variable was created. It was defined as the number of months between the beginning of the 1968 fiscal year and the end of the 1973 fiscal year. The mean of this variable is 72.03 months and its standard deviation is very low, .67. Accordingly, it did not have a significant influence in preliminary analyses and was eliminated from the final analyses.

Medical Education Involvement

The numerator of medical education involvement is the number of intern and resident positions filled during a particular year, as reported by the AMA (1969-75). The Project Survey also secured data about the number of interns and residents. The AMA data is highly correlated (.97 in 1973) with the Project Survey data, which confirms the validity of the former.

In order to indicate the extent of hospital participation in medical education, the number of interns and residents must be deflated by a measure representing hospital size. If this is not done, the intern and resident variable may stand as much for the total size of the hospital as for its concentration on medical education. Bed size, a semi-exogenous variable, was used for this purpose. The denominator of the medical education index is thus the number of hospital beds, which is defined later in this chapter.

Because of its greater precision, this index is superior to dichotomous measures which have been used in other studies to characterize the extent of medical education involvement. Such variables as presence of a residency and/or internship program, existence of medical school affiliation, and membership in the Council of Teaching Hospitals have the major weakness of not indicating the intensity of medical education involvement. Further, this index is more accurate than an analogous measure based on the number of internships and residencies offered, since in some hospitals substantial numbers of positions are unfilled.

As anticipated, the extent of variation in medical education involvement is large, with the coefficient of variation[1] equalling 3.88 in 1973. This variable changed little during the study years, with the average increase equalling 3%.

Local Exogenous Variables

Physician Variables

The numerator of the physician concentration measure is the number of nonfederal, patient care physicians in office-based practice. It was so defined in order to focus this variable on physicians devoting the great majority of their efforts to the delivery of patient care. The numerator of the general practitioner concentration measure is the number of physicians (defined as above) who are general or family practitioners. Both variables have county population as the denominator.

The data source for the numerators of these variables is the AMA (1969-74). County population is taken from Census data. The 1970 figures are actual Census counts, while the 1968, 1972, and 1973 figures are Census estimates.

Physician concentration changed very little during the study period, increasing by less than 1%. As in the country generally, general practitioner concentration declined substantially, -14%. The variation in both physician measures is substantial. In 1973 the coefficient of variation is .47 for physician concentration and .40 for general practitioner concentration.

As anticipated, the correlation between physician concentration and general practitioner concentration is modestly negative, -.23 in 1973. In contrast, but as also expected, the correlation between the percentage changes in these two variables is strongly positive, .55.

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[1] This statistic is defined as the ratio of the variable's standard deviation to its mean.

Extent of Private Insurance Coverage

Gross enrollment figures for hospital, surgical, medical and major medical insurance coverage are computed annually by state and for the entire United States by the Health Insurance Association of America. In addition to these enrollment estimates, which are calculated from data submitted by individual insurance companies, enrollment estimates for selected geographic areas and for the nation have been computed from consumer survey data collected by the National Center for Health Statistics and by Andersen and Anderson (1967). However, such data is not feasible for this project because it does not cover all study counties.

Chiswick (1976) developed a method for estimating the extent of insurance coverage in Standard Metropolitan Statistical Areas (SMSAs). Using state-level data, he computed a regression equation which explained approximately 71% of state-level differences in per capita hospital and surgical insurance benefits (HI). The resulting equation included a small set of occupation and industry measures, taken from Census data, as independent variables. SMSA-level values for these measures were then substituted into the equation to predict HI for the SMSAs.[2]

O'Donoghue et al. (1976) used a similar approach. A regression equation was developed to explain differences in the level of health insurance coverage among 39 states, and was then used to estimate the level of health insurance coverage in the SMSAs included in that study sample.

Based on the premise that most private health insurance coverage is provided via group plans offered to various employee groups, and that the extent to which the employed labor force is insured varies by occupational or industry group, the measures included in the potential independent variable set were the proportions of workers employed in seven industry categories in 1970 (Bureau of the Census, [1973]), and the percentages of workers employed in 12 occupational groups, drawn from the fourth count data of the 1970 Census. As was done by Chiswick, per capita health insurance expenditures was used as the dependent variable since such a measure reflects both the number of persons with insurance and the depth of coverage.[3]

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[2] Chiswick's equation is as follows:

$$HI = -32.48 - 2.51(\%\ \text{Local}) + 0.68(\%\ \text{MANUF}) + 2.05(\%\ \text{WC}) - 1.34(\%\ \text{FED}),$$

where % Local = % employed population in local government, 1962;
% MANUF = % employed population in manufacturing, 1960;
% WC = % employed population white collar, 1960; and
% FED = % employed population in federal government, 1965.

[3] Admittedly, this measure is imperfect for this purpose since it is affected by factors other than the extent of health insurance coverage.

The resulting regression equation is shown in Table 9-1. Its predictive power is high with an R^2 of .71. There is little collinearity: The determinant is .75 and the highest covariance ratio is .23. The effects of the independent variables are in the expected directions. That is, self-employed managers and construction workers are frequently not covered by health insurance, whereas the opposite usually characterizes white collar workers.

Table 9-1

EQUATION FOR PRIVATE INSURANCE INDEX

Dependent Variable: Per Capita Health Insurance Expenditures, 1970

R^2 = 0.71
Determinant = 0.75

Constant = $+10\times10^1$

Independent Variable	Coefficient	Elasticity (in %)	t-Value	Covariance Ratio
% Employed in Construction (1970)	-66×10^1	-58.3	-4.33	0.05
% Employed as White Collar, Sales, and Clerical Workers (1970)	$+21\times10^1$	+65.3	+2.91	0.21
% Self-Employed Managers and Administrators (1970)	-18×10^2	-44.0	-4.36	0.23

This equation is thus both statistically and substantively solid. Accordingly, it was applied to county data in order to calculate the private insurance index for the study counties. That is, each county's values for the three independent variables were placed in the equation in order to determine the private insurance index for that county.

Since the private insurance index is developed from 1970 Census data, only one value for this variable is available. The degree of variation in this index is moderate, with the coefficient of variation equalling .27. As expected, the correlation between the index and income level is high, .72. Even so, slightly more than 50% of the variation in each variable is independent of the other. Both are thus included as exogenous variables, although as discussed in Chapter 8, the income variable is expected to have a stronger effect.

Income Level

The following five variables were considered as potential measures to characterize county income level:

- median family income
- percent of families with incomes below 125% of the poverty level
- percent of families with incomes between 125% and 199% of the poverty level
- percent of families with incomes equal to or greater than 200% of the poverty level
- percent of families with incomes above 300% of the poverty level

Although each measure conceptually represents a different dimension of income level, in actuality they are strongly related, as shown in Table 9-2. Hence, little can be gained by using more than one income measure. Median income was selected as the single variable for three reasons. First, it is influenced by the income of all families in the county; second, it is correlated at greater than the .90 level with all the other income variables; and third, it has been used frequently by other analysts.

Table 9-2

CORRELATIONS AMONG INCOME VARIABLES

	Median Income	Income <125% of Poverty Level	Income >125% and <199% of Poverty Level	Income ≥200% of Poverty Level
Income <125% of Poverty Level	-.91			
Income >125% and <199% of Poverty Level	-.93	+.83		
Income ≥200% of Poverty Level	+.96	-.96	-.95	
Income >300% of Poverty Level	+.96	-.91	-.96	+.98

Median income is drawn from the 1970 Census, but is based on 1969 data. The variation in this measure is modest; its coefficient of variation equals .14.

Urban/Rural Character

Three variables were primarily considered to represent urban/rural character. They are mutually exclusive measures derived by the Bureau

of Census: the percentage of the county population that is urban; the percentage that is rural nonfarm; and the percentage that is rural farm. The former measure, termed urban population, is that portion of the county population that resides in urbanized areas, i.e., areas with 2,500 or more inhabitants. The latter measure, termed farm population, is that segment of county residents who live in rural areas and reside on sales-producing farms. Correspondingly, the remaining measure is that portion of the population which is neither urban nor rural farm.

The correlation between urban population and the rural nonfarm measure is -.95. It would thus be redundant to use both measures, and rural nonfarm was deleted. Urban population is also negatively associated with farm population, but to a lesser extent, -.72. Approximately one half of the variation in each of these measures is thus independent of the other. Since farm population and urban population also differ conceptually, representing different dimensions of county urban/rural character, both variables were retained.

The variation in these measures is large compared to the other socioeconomic variables. This is particularly true for farm population whose coefficient of variation is .95, but it also holds for urban population, whose coefficient of variation is .48. As expected, both urban population and farm population are strongly associated with income level, with the respective correlations equalling .66 and -.60. Further, both variables are highly associated with physician concentration. The 1973 correlation between the latter variable and urban population is .53, while the corresponding statistic for farm population is -.45.

Another urban/rural dimension potentially influencing hospital behavior is location of study hospitals in very large SMSAs, such as Chicago or Detroit. A dichotomous variable, termed Detroit/Chicago location, was created to indicate location in either SMSA (with [1]) indicating such location and [0] the absence of such location). This variable was designed specifically to investigate whether location in Chicago or Detroit might be responsible for possible differences in cost or other endogenous variables between Indiana and control hospitals. The Detroit/Chicago index is not duplicative of the urban and farm measures for its correlations with those variables are respectively .39 and -.30.

The percentage of Michigan control hospitals located in Detroit is higher than the percentage of Tristate control hospitals situated in Chicago. Accordingly, the mean of this variable is higher in the Michigan analysis group (.09) than in the Tristate analysis group (.04).

Other Socioeconomic Characteristics

The white population measure is the percentage of the county population who are white. White is defined by the Census as individuals who indicate they are white, Mexican, Puerto Rican, or other Indo-European nationality. Education level is the median education of the

county population, i.e., the median years of school completed by persons at least 25 years of age. The pediatric population measure is the percentage of the county population who are under 5 years of age. The elderly population variable, used only in Segment III, equals the percentage of the county population who are at least 65 years of age.

The first three variables are taken from Census data and are based on the year 1970. The source for the latter measure is the SSA (1970 and 1973) since this source permits the construction of this variable for both Segment III years, 1970 and 1973. The variation in these indices is generally low, although there are significant differences in this regard. The coefficient of variation ranges from .04 for education level to .24 for elderly population in 1973.

As expected, white population exhibits a correlation pattern typical of the Midwest, and probably of the Northeast and West, but distinctly different from that prevailing in the South. This factor has a substantial negative correlation with income level, -.48; an even stronger negative correlation with urban population, -.63; and a strong positive correlation with farm population, .52. As also anticipated, education level is more strongly associated with income level (.52) than with any other local exogenous variable.

Semi-Exogenous Variables

Type A Variables

Hospital emergency/outpatient involvement is represented by the ratio of outpatient and emergency room charges to total charges. A variable based on charges is preferable to one based on visits, since charges reflect not only the number of visits, but also their intensity.[4] Charges are also preferable to costs, since emergency room and outpatient costs do not include the ancillary, hotel, and administrative expenses incurred by these types of patients.[5]

As with emergency/outpatient involvement, from a substantive perspective the best measure to represent extended care facility (ECF) involvement would be the ratio of ECF charges to total charges. However, a small amount of missing data existed for this variable in the Segment I sample. The correlation between the ratio of ECF charges

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[4] This point is also emphasized by Shuman, Wolfe, and Hardwick (1972).

[5] Even if it were desirable, it is not possible to accurately separate outpatient and emergency room charges in the Medicare Cost Reports for all study hospitals. Small hospitals combine the two types of charges (and other statistics, such as costs or visits), while large hospitals report these charges separately.

to total charges and the ratio of ECF beds to acute hospital beds (excluding ECF beds) was examined and found to be high, equalling .98 in 1973. Hence, the ECF bed index, for which there was no missing data, was selected as the ECF variable for Segment I. However, in the Segment II and III samples, no missing data existed for the ECF charges variable. Because of its substantive preferability, the ECF charges index was used in those segments.

Study hospitals are substantially involved in ECF care and emergency/outpatient services, but such involvement is still much lower than the extent of acute hospital activity. In 1973 the ECF bed index averaged .08 for Segment I hospitals, and the ECF charges index averaged .018 for Segment II hospitals. (The mean of the latter variable is approximately the same for Segment III hospitals.) In contrast, emergency/outpatient involvement averaged .10 for both Segment I and Segment II hospitals, so that in terms of charges, average emergency/outpatient involvement is more than five times as great as average ECF involvement.

Emergency/outpatient involvement increased substantially during the study period, with the average increase equalling 54%. The rise was even more dramatic for the ECF bed index (228%), but the ECF charges index exhibited very little change (1%) because the greater increase in ECF beds was offset by the higher inflation in acute hospital charges.

While the variation in these factors is substantial, it is much higher for the ECF indices than for the emergency/outpatient measure. In 1973 the coefficient of variation for the latter is .47; this statistic is 3.00 for the Segment I ECF bed index and 3.11 for the Segment II ECF charges index.

Type B Variables

Length of stay is defined as the average duration of a hospital case, i.e., the number of patient days divided by the number of cases. ECF and newborn infant utilization are excluded from both patient days and cases.

Elderly caseload is represented by the ratio of Medicare patient days to total patient days, i.e., the percentage of the latter consumed by Medicare patients. Like the denominator, the numerator of this variable excludes ECF utilization. Patient days, rather than cases, were used as the basis for this variable since there was a modest amount of missing data for Medicare cases.

The elderly caseload variable is thus based on the presumption that Medicare Part A beneficiaries are aged 65 or older. This is not precisely correct since at the end of the study period such beneficiaries included some disabled individuals under 65 and some chronic renal disease patients under 65. Nonetheless, the vast majority of Part A beneficiaries were at least 65 years of age, and the assumption underlying this variable is thus valid.

Bed size is defined as the number of bed days available for the year, divided by 365 days. A single bed day available is defined as the availability of a bed for a potential patient for one day. Bed days available encompasses hospital beds, cribs, and pediatric bassinets maintained for inpatients, but not newborn bassinets or ECF beds.

Defining the bed size variable in this way takes into account intra-year variations in the number of beds. It is thus superior to a bed size measure based on the number of beds at either the beginning or end of a reporting period. It is also superior to licensed beds, a figure which often varies substantially from the number of beds in operation.

In 1973 average length of stay for the study hospitals was 7.49 days. During the study years there was a modest decline in this variable; it decreased by 6%. Elderly caseload averaged .38 for the study hospitals in 1973. That is, almost 40% of hospital utilization was provided to elderly patients. This measure changed very little during the study period, increasing by 2%. In 1973, average bed size in the study hospitals was 194. This variable changed modestly during the study period, increasing by 14%.

The variation in length of stay is appreciable, but not large. In 1973 its coefficient of variation is .18. Variation is somewhat higher in elderly caseload with its coefficient of variation equalling .25 in 1973. In contrast, but as expected, variation in bed size is much greater. Its coefficient of variation equals .88 in 1973.

Summary

Table 9-3 specifies the exogenous and semi-exogenous variables used in this study. Those variables included in only certain segments are so indicated in the table. Bed size and the percentage change in bed size are shown separately since the former is a semi-exogenous variable in all segments, but the latter is a semi-exogenous variable only in Segment I.

Table 9-3

EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

Hospital Exogenous Variables	Local Exogenous Variables
Nonprofit Control	Physician Concentration
Church Control	General Practitioner Concen.
Fiscal Year	Private Insurance Index
Medical Education Involv.	Income Level
Semi-Exogenous Variables	Farm Population
ECF Involvement	Urban Population
Emergency/Outpatient Involv.	Detroit/Chicago Location
Length of Stay (Segments I & II only)	White Population
Elderly Caseload (Segments I & II only)	Education Level
Bed Size	Pediatric Population
% Δ Bed Size (Segment I only)	Elderly Population (Segment III only)

IV.

Segment I: Influence on Cost and Productivity

The central function of this segment is to determine whether the Indiana Program accomplishes its main purpose. That is, does the Program reduce hospital costs? Two sets of analyses -- the regression and time trend analyses -- are used to accomplish this goal, i.e., to determine the Indiana system's impact on total cost.

This segment thus attains the first study objective. It also has two other important functions. First, it ascertains which of the major hospital departments are influenced by the Indiana system. Second, it determines if and to what extent the Program impacts cost by influencing productivity and resource usage. This segment thus makes substantial progress toward the achievement of the second study objective.

All segment results except the time trend findings are derived from regression analysis -- a powerful technique since it takes into account the effects of other variables in determining the Program's influence. All regression results described as being positive or negative are statistically significant at least at the .05 level. The regression findings emphasized in this and later segments are the Program's percentage and dollar impacts on different variables.

The main study sample is used in this segment. The characteristics of the study Indiana hospitals closely resemble those of the Indiana hospital universe, allowing the Segment I results to be generalized to that universe. Except for the time trend analyses, the Segment I analyses are based on the main study years, 1968 through 1973, with emphasis placed on the results for the end years of this span. The principal data sources are Medicare Cost Reports, AHA Survey, and Bureau of Census information.

Chapter 10 develops this segment's substantive framework, specifying hypotheses which are tested in the regression analyses. Chapter 11 describes the characteristics of the Segment I endogenous variables. Chapters 12 and 13 are companion chapters since both discuss the analysis results. The former describes the cost findings, and the latter the productivity and resource usage results.

10.
Expected Impact of the Program

The purpose of this chapter is to construct the substantive framework for the Segment I regression analyses. Its specific product is a set of hypotheses which are explicitly tested in these analyses. Since Segment I is the first study segment, the concepts developed in this chapter also provide part of the substantive base for the Segment II and III analyses.

An important source for this chapter as well as for Chapters 14 and 18 (the analogous Segment II and III chapters) is the characterization of the Indiana and control state programs in Chapters 2 and 3. Another is the derivation of a behavioral model for hospitals in Appendix A. As indicated there, this model can be consolidated into an objective function which has three arguments -- financial position of the hospital, professional status of the hospital, and financial position of physicians.

Specification of the objective function in this way makes several points clear. First, both the administrative staff and the physician staff are important decision makers in the hospital environment. Second, at times there will be tension between the administrative staff worried about the financial position of the hospital and the physician staff concerned about their own financial position.

Third, since both the administrative and physician staffs are interested in the professional status of the hospital, there will often be general agreement based on this joint interest. Even so, conflict may arise among hospital decision makers because of the inevitable trade-offs between the hospital's professional status and its financial status and/or the financial position of its physician staff. These concepts and others in Appendix A are used in this and later chapters to develop the study substantive framework.

The first two chapter sections discuss respectively total cost and the departmental costs. The next two sections are devoted to productivity and resource usage, while the last section considers the effects of productivity and resource usage on cost. Each of these sections has three subsections. The first defines in general terms the endogenous variables addressed.[1] The second describes the importance of these variables; and the third discusses the expected impact of the Indiana Program on the variables.

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[1] Chapter 11 expands upon this chapter's general definitions by describing in detail the construction of the endogenous variables.

The hypotheses specifying the Program's impact are developed for the end years of the main study time period -- 1968 and 1973 -- and for the percentage change between these years. In Segment I the Program's effects in 1970 and 1972 are also analyzed, but these results are used for supplementary purposes rather than as primary analytical benchmarks. Accordingly, hypotheses are not developed for these two years.

The hypotheses incorporate two conditions. First, if a hypothesis specifies a positive or negative effect, that effect is expected to be significant at least at the .05 level. Second, since a hypothesis indicates the expected result of a regression analysis, it should be interpreted in a multivariate context. That is, each hypothesis specifies the expected influence of one variable on another, taking into account the effects of other variables.

Total Cost

Definition

Both the case and the patient day are important measures of hospital output. Accordingly, the two cost variables most commonly employed in hospital studies have been cost per case[2] and cost per patient day.[3] The former variable is used in this study since the case is a more discrete unit than is the patient day. That is, the primary unit of hospital care is the tonsillectomy, complicated delivery, or treatment for gastroenteritis, rather than the individual patient day for any of these conditions.

In this study total cost is thus defined as hospital cost per case, i.e., all patient care expenses divided by all inpatient cases (excluding newborn and extended care facility cases). This variable indicates the average total cost of treating a hospital case.

Importance

As discussed in Chapter 1, the main purpose of prospective rate setting programs is to control hospital costs. Total cost is consequently the

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[2] Some analysts refer to this variable as cost per admission, while others define it as cost per discharge. These three terms are synonymous since the case, admission, and discharge are essentially identical measures. All refer to discrete episodes of hospital care characterized by an uninterrupted hospital stay.

[3] Some investigators including Shuman, Wolfe, and Hardwick (1972) have used total hospital expenses as the main dependent variable. However, this approach has two serious weaknesses. First, as pointed out by Lave and Lave (1978), heteroskedasticity is almost inevitably severe. Second, the variation in total expenses is too readily explained by factors related to hospital size.

focal point of the study analyses. It is the sole subject of the first study objective; it is central to the second, fourth, and sixth objectives.

Effects of Indiana Program

As discussed in Chapter 2, it is the serious intent of the Indiana Program to control hospital costs. The Program has sufficient power and resources to effectively pursue this objective. Equally important, the system is operated in a knowledgeable and flexible manner. It is thus likely that the Indiana Program has a negative impact on hospital costs.

It is also likely that this impact is stronger in 1973 than in 1968. During the study years the Indiana system continued to develop. Its specific techniques and general operating style improved. It became more confident and aggressive. As a consequence, its role broadened and it became more serious about restraining hospital costs. In short, during the study period the Program's expertise in controlling hospital costs steadily expanded.

It is possible that during the later study years the impact of ESP in the control states was sufficient to blunt the increasing effectiveness of the Indiana Program. That is, even if the Indiana Program had an increasing influence on cost during the study years, this effect may not be manifest in the cost analyses because of ESP's influence on control hospital costs in the later, but not the earlier, study years.

However, such a result is unlikely for a number of reasons. First, ESP was widely resented by hospitals in the control states as well as in Indiana -- a point evident in both Project Survey responses and site visit discussions. Second, most hospitals thought (accurately) that ESP would be a short-run phenomenon. As a consequence, in response to ESP pressure hospitals were not willing to undertake permanent management changes designed to save costs.

Third, as discussed by O'Donoghue (1974), not only were ESP regulations complex, but they were frequently changed. It was thus difficult for hospitals and others to grasp the import of the regulations. Fourth, as pointed up by Lipscomb, Raskin, and Eichenholz (1978) as well as others, ESP regulations at times provided perverse incentives. For example, under ESP even those hospitals in a negative cash flow position did not have strong incentives to reduce costs.

The expected weak influence of ESP in the study states is consistent with the results of Ginsburg (1978). He found that ESP did not have a restraining effect on hospital costs. He indicates that the ambiguity and transience of ESP regulations, as well as the negative incentives they sometimes created, may have been responsible for ESP's failure to reduce hospital cost inflation.

As described in Chapter 3, the prime difference between the Type I and Type II control environments is that the latter has strong planning or capital expenditures regulation, while the former does not. By definition the objective of such regulation is to control hospital utilization of capital resources. While many planning programs fail to achieve this objective, some may succeed in attaining it. If so, the planning program may decrease the bed growth of individual hospitals and thereby the aggregate concentration of hospital beds (beds per capita for a defined population). If the latter result occurs, it will almost certainly produce a concomitant decrease in aggregate hospital utilization (hospital cases per capita for the same population).[4],[5] The utilization effect may in turn lower aggregate hospital costs (costs per capita for the same population).

Yet even if a planning program is successful in producing all these effects, hospital cost per case is not likely to substantially decline as a result.[6] The reason is that the capital sector is small compared to the hospital as a whole. For example, hospital labor expenses far outweigh hospital capital expenses. Regulation of hospital capital utilization is thus an insufficient lever for influencing the breadth of hospital operations, as is necessary to reduce cost per case.

It is possible that by lowering the percentage change in bed size a planning program may improve hospital occupancy and thus lower cost per case, but this effect is usually not substantial except in the short run. It is also possible that a planning program could lower cost per case by exerting such a strong influence on service mix that the nature of hospital output is dramatically changed. However, at present an effect of this magnitude is little more than a hypothetical possibility in the United States.

It is thus unlikely that the Michigan Type II environment is significantly more effective in constraining hospital costs than is the

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[4] Shain and Roemer (1959) are generally credited with first pointing up the strong positive relationship between bed concentration and hospital utilization, although Meyers (1954) found the same relationship in an earlier study using Saskatchewan data. A number of later studies have demonstrated the strong positive impact of bed concentration on hospital utilization. Among them are Feldstein (1971), Davis and Reynolds (1975), Chiswick (1976), and O'Donoghue et al. (1976).

[5] A reduction in such hospital facilities as operating rooms or x-ray equipment can produce a similar impact on utilization, but the beds effect is usually predominant.

[6] In fact, it is more than a remote possibility that cost per case will rise since the utilization effect may increase case intensity.

Tristate Type I environment. Hence, the Indiana Program's cost impact in the Michigan analyses is not expected to differ substantially from its cost influence in the Tristate analyses.

Prior to this study, Pauly and Drake (1970) were the only investigators to use regression analysis to examine the effects of the Indiana Program. The Program is not the sole subject of their project, but it was an important focus. They found that the Indiana Program had a negative impact on 1966 cost per case in analyses comparing Indiana and Illinois hospitals, but an insignificant influence on this variable in analyses comparing Indiana and Wisconsin hospitals.

These results and this study's expected findings are compatible. Even if the Program's cost effects were insignificant in both sets of Pauly and Drake's analyses, such a finding would not be contradictory to this project's expected results. The Indiana system could well have an insignificant effect in 1966 and a modest negative impact in 1968.

Further, this study is able to draw upon the efforts of earlier projects, such as the Pauly and Drake study. As a partial consequence, its methodology is more advanced than that employed by Pauly and Drake -- a difference which could account for possible divergent findings in the two studies. As an example of a methodologic difference, Pauly and Drake employed AHA Survey data to construct their cost variables, whereas this project used Medicare Cost Report data. As another example, this study can identify more precisely the cost impact of the Indiana Program because it takes into account the cost effects of a wider range of exogenous/semi-exogenous variables.

In summary, the following hypotheses will be tested in this area.

(1) The Indiana Program will have a strong negative impact on total cost in 1973, a smaller negative influence on total cost in 1968, and a substantial negative effect on the percentage change in this variable between these years.

(2) The Program's effects on total cost will be similar in the Michigan and Tristate analyses.

Departmental Costs

Definition

Three departmental cost variables are analyzed. Analogous to total cost, each is defined as departmental expenses per case. One such variable focuses on the expenses of acute care inpatient units, such as medical/surgical, pediatrics, and intensive care. The common task of these units is to provide basic care to the patient, i.e., the range of services encompassed within the broad definition of nursing care. Accordingly, this variable is termed nursing cost.

Another departmental cost includes the expenses of units which provide diagnostic or therapeutic services, not including nursing care. Examples of such units are radiology, blood bank, and physical therapy. In accord with customary usage, this variable is termed ancillary cost.

The third departmental cost includes the expenses of units providing services similar to those of a hotel or common to the administrative function of any institution. Encompassed within this definition are such units as dietary, housekeeping, and general administration. Consistent with the nature of these units, this variable is termed administrative/hotel cost.

Together these departmental costs account for more than 90% of total cost. The largest is administrative/hotel cost which comprises about 45% of total cost. The other departmental costs are approximately equal, each representing about 25% of total cost.

Importance

The purpose of these analyses is to determine whether the Program has differential effects on the departments. It is important to ascertain whether its impact extends across all departments or is confined to only one or two departments. In general, the Program's influence is more likely to continue and accelerate over time if it is a hospital-wide effect. For example, an insignificant impact by the Program on ancillary cost would indicate that ancillary units are beyond the reach of the Program, thus constituting a barrier limiting its influence.

Effects of Indiana Program

Largely because rate decisions are based on a review of the total hospital budget, the Indiana Program is evenhanded in its treatment of different departments. However, certain departmental characteristics influence the Program's ability to impact different departments.

Such characteristics can be collapsed into four general factors. One is the labor dominance of the department (i.e., the ratio of labor inputs to all inputs). As discussed in later chapters, the hospital can more easily affect labor cost than nonlabor cost. In the latter area, while the hospital can often affect input quantities, it generally has little influence on input prices. For example, it has no control over electricity or natural gas prices.

Another factor is the ability of the hospital to affect wage rates within departments. This ability arises because hospitals are major employers in some of their labor markets. In general, the higher the ratio of hospital-employed personnel of a given type to all employed personnel of that type, the greater is the hospital's capacity to influence wage rates. For this reason the hospital has more control over the wages paid to specialized health personnel, such as nurses

and laboratory technicians, than over the wages paid to unspecialized personnel, such as custodians or food service helpers.[7]

The third factor is the ability of the administrative staff, as opposed to the physician staff, to affect the intensity of services provided by the department. As discussed in Chapter 2, physicians are relatively distant from the Indiana Program. If service intensity in a department is primarily controlled by the physician staff, it will be refractory to the Program's efforts.

The remaining factor is the ability of the administrative staff, again as compared to the physician staff, to organize the delivery of services by the department. The issue here is the degree of managerial freedom allowed the administrative staff in different departments.

The hospital can substantially influence the wage rates of nursing personnel, especially registered nurses and licensed practical nurses beyond the entry level. This capacity arises because hospitals are sizeable purchasers of nursing services in local labor markets. Even more important, the labor dominance of the nursing department is very high. In general, nursing care does not entail heavy usage of non-labor inputs -- a characteristic further accentuated because drug and supply expenses are charged to pharmacy and central supply, which fall under administrative/hotel costs.

The administrative staff has partial control over the intensity of nursing services. While physicians order specific services for individual patients, the administrative staff establishes the general level of nursing intensity, operating under the constraint that if such intensity becomes too low, physicians and patients will object. The administrative staff also has substantial flexibility in the deployment of nursing personnel. It can alter the skill mix of nursing personnel, rearrange nursing units within the hospital, and change the work patterns of individual nursing stations.

Among the three departments, the administrative staff has the most control over service intensity in the administrative/hotel department. By their nature administrative/hotel services are peripheral to direct patient care and consequently physicians are least concerned about their intensity. In this department the administrative staff also has the greatest discretion in deploying resources. However, the hospital has less control over wage rates in this department than in the nursing department since many administrative/hotel employees are semiskilled. Further, labor dominance is lower in this department than in the nursing

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[7] Feldstein (1970a) showed that approximately 50% of hospital cost inflation between 1955 and 1968 was due to increases in wage rates. Further, wage rates of more skilled hospital employees increased more rapidly than those of less skilled employees.

department. This is particularly true of such units as dietary, pharmacy, and plant operation.

In the ancillary department service intensity is primarily controlled by physicians, who prescribe the therapeutic and diagnostic procedures determining such intensity. The management options of the administrative staff are also more constrained by physician concerns and preferences in this department than in the other departments. Among the three departments, however, wage rates in this department are the most sensitive to hospital actions. Most ancillary personnel are specialized to the health care field and some are specialized only to hospitals. However, the effect of this factor is constrained to some extent because the ancillary department stands intermediate between the other departments in terms of labor dominance.

Table 10-1 summarizes these discussions by showing the differences among the departments in terms of these four factors. Three premises emerge from the departmental patterns shown in this table. First, all the departmental costs are likely to be negatively influenced by the Program. For reasons analogous to total cost, the Program's effects on the departmental costs are expected to be greater in 1973 than in 1968. Second, the departmental cost most strongly impacted is probably nursing cost. Third, the Program is likely to more strongly affect ancillary cost than administrative/hotel cost.

Table 10-1

FACTORS INFLUENCING THE PROGRAM'S EFFECTS ON DEPARTMENTAL COSTS

	Labor Dominance	Hospital's Ability to Affect Wage Rates	Administrative Staff's Capacity to Influence Service Intensity	Administrative Staff's Ability to Organize Service Delivery
Nursing Department	high	moderately high	moderate	moderately high
Administrative/ Hotel Dept.	moderate	moderate	high	high
Ancillary Department	moderately high	high	low	moderate

In summary, the following hypotheses will be tested in this area.

(3) The Indiana Program will have a strong negative influence on nursing cost in 1973, a negative effect on nursing cost in 1968, and a negative impact on the percentage change in this cost. Its impact on nursing cost will be stronger than its effects on the other departmental costs.

(4) The Indiana Program will have a negative effect on ancillary cost in 1973, a weakly negative or insignificant influence on this variable in 1968, and a negative impact on the percentage change in this cost. The Program's influence on ancillary cost will be greater than its impact on administrative/hotel cost.

(5) The Indiana Program will have a negative impact on administrative/hotel cost in 1973, a weakly negative or insignificant influence on this cost in 1968, and a negative effect on the percentage change in this cost.

Productivity

Definition

In general terms, productivity indicates the quantity of output that can be produced by a given number of inputs, i.e., the ratio of outputs to inputs. In this study labor productivity and capital productivity are analyzed. Both productivity variables compare units of output to units of input.[8] The measure of hospital output employed in this study is the case. Labor inputs are measured as the number of full-time equivalent personnel (FTEs). In accord with the general definition of productivity, labor productivity equals cases per FTE.

Since no single measure encompasses all types of capital inputs, the size of the basic hospital plant -- the number of acute care beds -- is used to represent the number of capital inputs. Capital productivity is therefore defined as cases per bed. It is analogous to the occupancy rate, a widely used hospital statistic.

Importance

The importance of these analyses rests on the strong relationship between productivity and cost: If more output can be produced by a

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[8] Productivity can also be measured in terms of dollars of output to dollars of input, or the two types of measures can be crossed, such as dollars of output per units of input, or units of output per dollars of input. None of these alternative measures are necessary in this study given the types of resource usage variables analyzed.

given number of inputs, cost per output will be lower.[9] Productivity is thus expected to be a major determinant of cost, exerting a negative influence. It therefore constitutes an important mechanism through which the Indiana Program could impact cost. These analyses are consequently a key element in the process of determining how the Program reduces cost.

Because of the hospital's labor dominance, labor productivity is likely to have a much larger impact than capital productivity on cost. Labor costs usually account for about 60% of total hospital costs, while capital costs represent less than 10% of such costs. As a result, to exert an equal influence on cost through the two productivities, a prospective rate setting program must have a much greater impact on capital productivity than on labor productivity.

Effects of Indiana Program

The Indiana Program is likely to have a positive impact on both labor productivity and capital productivity. Since 1965 the Program has required prior approval of proposed hospital capital expenditures by planning agencies in order for recovery of such expenditures to be incorporated in the hospital's rate structure. Even before that time hospital capital expansion had to be in accord with planning principles. Further, the Program rigorously scrutinizes the hospital's overall occupancy rate as well as the occupancy rates of different nursing units.

Its stress on appropriate labor usage is even stronger. The Indiana system persistently questions hospital staffing patterns, particularly stressing the total number of employees utilized by the hospital. It forces hospitals to justify their overall use of personnel, and if necessary, it examines departmental staffing patterns in depth.

Equally important, productivity is a factor clearly within the potential influence of the administrator. One of his/her primary roles is to determine the number and types of inputs the hospital should employ. Another important function is to arrange efficient combinations of inputs. In addition, the administrator can establish formal and informal incentives to reward improved work performance by individual employees.

In the hospital industry as in other industries, labor inputs can be changed more rapidly than capital inputs, especially the basic hospital plant. As discussed earlier, five or even ten years frequently transpire between the initial planning of new hospital facilities and the operational use of such facilities. While hospital beds can be

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[9] This effect will not occur in situations where the unit price of each input rises to offset the productivity gains. However, such situations are rare and do not appreciably reverse the usual negative impact of productivity on cost.

closed in a much shorter time, administrators and board members are usually loath to take this step and are often pressured by consumers to keep sparsely used facilities open.

For this reason the Program's effect on labor productivity should have been felt more rapidly than its impact on capital productivity. Partially offsetting this factor, however, is the greater emphasis that was implicitly placed on capital productivity during the initial years of the Program's operation. Balancing these factors, the Program's impact on both types of productivity is likely to be either insignificant or only modestly positive in 1968.[10] In contrast, its productivity effects in 1973 are expected to be substantial.

In summary, the following hypotheses will be tested in this area.

(6) The Indiana Program will have a positive impact on labor productivity in 1973, a modestly positive or insignificant effect on this variable in 1968, and a positive influence on the percentage change in this variable.

(7) The Indiana Program will have a positive influence on capital productivity in 1973, a modestly positive or insignificant impact on this variable in 1968, and a positive effect on the percentage change in this variable.

Resource Usage

Definition

As with productivity, these analyses concentrate on the hospital's utilization of labor and capital. Three resource usage variables are examined in Segment I. One is average salary, which equals payroll (all salaries and wages) divided by FTEs. Another is capital intensity, which equals capital assets per bed, with the numerator defined as the net value of plant and equipment. The other is payroll/cost, defined as payroll divided by total expenses.

By its nature capital intensity is more sensitive than the other Segment I variables to accounting differences among hospitals. It must thus

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[10] As with cost, the findings by Pauly and Drake (1970) are consistent with the 1968 hypothesis for capital productivity. In their Indiana/Illinois comparison the Program has a positive effect on the occupancy rate, but in their Indiana/Wisconsin comparison the Program's influence is insignificant. However, the predictive power of the latter equation is very low, suggesting that the occupancy rate of Wisconsin hospitals is heavily influenced by idiosyncratic factors. The R^2 is .01 in the Indiana/Wisconsin equation compared to .24 in the Indiana/Illinois equation.

be regarded as more of an approximation than the other variables. Even so, it is sufficiently accurate to indicate important differences in capital intensity among hospitals.

Importance

The main purpose of these analyses is to examine two important mechanisms through which the Program could influence cost. One is average salary which is expected to have a strong positive impact on cost. The other is capital intensity, also expected to have a positive effect on cost. Accordingly, the Indiana system could impact cost through either or both variables.

The other purpose of these analyses is to definitively test the general thesis enunciated earlier -- that the Indiana Program has a stronger impact on labor cost than on nonlabor cost, i.e., that its influence on payroll/cost is negative. This thesis is central to the expected findings of the departmental cost analyses, and to a lesser extent, the labor productivity and average salary analyses.

Effects of Indiana Program

Average salary is determined by the wage rates and skill mix of hospital personnel. Both these factors are systematically examined by the Indiana system. Both are within the purview of the administrative staff. It is therefore likely that the Indiana Program has a negative influence on average salary and that this influence progressively increases during the study years.

The Indiana Program may decrease capital expenditures (a possibility analyzed in Segment II), but it has taken a balanced stance in doing so, scrutinizing equally the construction of beds and the development of other facilities. Consequently, the Program is not expected to have a significant impact on capital intensity in the Tristate analyses.[11]

Unlike the Indiana Program, the Michigan program has stressed regulation of bed growth, although its scope has extended to other types of capital development. It is thus probable that the Michigan program increases capital intensity by shifting capital expenditures from the construction of beds to the acquisition of equipment and the building of ancillary, emergency/outpatient, and other non-bed facilities.

Salkever and Bice (1978) demonstrate a similar type of effect. They found that between 1968 and 1972 certificate of need programs in this

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[11] A negative effect by the Program on capital expenditures could be sufficient by itself to produce a negative influence on the percentage change in capital intensity. However, this possibility is unlikely because while the association between these two variables is expected to be positive, it is also expected to be modest in magnitude.

country had an insignificant effect on the change in hospital plant assets, a negative influence on the change in hospital beds, and a positive impact on the change in hospital capital intensity (plant assets per bed).

Capital intensity is therefore likely to be higher in Michigan hospitals than in Indiana hospitals. However, it is also likely that the causative agent is not the Indiana system, but rather the Michigan program. Because of the time required for the completion of capital projects, the capital intensity effect is not expected to become significant until the later study years. It is also not expected to be large enough to produce a significant impact in the Combined analyses.

As stressed earlier, a feature of the Indiana Program is balanced scrutiny of the hospital. It carefully examines not only labor usage, but also capital and supply/service usage. As also discussed, the prices of most nonlabor inputs are outside the influence of hospitals in a single state. Many are refractory to the actions of the hospital industry generally, e.g., the prices of raw food and electricity. In contrast, hospitals can influence the wage rates paid to most of their personnel. Largely because of this differential effect on labor and nonlabor prices, the Program is expected to have a negative influence on payroll/cost. However, the magnitude of this influence is not likely to increase between 1968 and 1973. In fact, it may decrease as the Program exerts an accelerating influence on supply/service and capital costs during the study period.

In summary, the following hypotheses will be tested in this area.

(8) The Indiana Program will have a strong negative influence on average salary in 1973, a negative impact on this variable in 1968, and a negative effect on the percentage change in this variable.

(9) In the Tristate and Combined analyses the Indiana system will have an insignificant effect on capital intensity in 1973 and 1968, and an insignificant influence on the percentage change in this variable. Michigan hospitals will exhibit a higher capital intensity than will Indiana hospitals. However, this result will be due to the Michigan program, not to the Indiana system. In the Michigan analyses the capital intensity effect will be present in the 1973 and percentage change findings, but not in the 1968 results.

(10) The Indiana Program will have a negative impact on payroll/cost in 1973 and 1968, and an insignificant influence on the percentage change in this variable.

Effects of Productivity and Resource Usage on Cost

Definition

As discussed in Chapter 4, the model for this study's regression analyses is based on three steps. The cost analyses discussed earlier are Step A analyses; the productivity and resource usage analyses are Step B analyses. The analyses addressed in this section are the main Step C analyses of this study.

The objective of Step C is to determine the effects of endogenous variables on cost, taking into account semi-exogenous variables. Four endogenous variables in this segment may have a direct impact on cost: labor productivity, capital productivity, average salary, and capital intensity. Payroll/cost is not included in these analyses because it is the ratio of two types of expenses. It reflects a number of influences within the hospital, but does not directly impact total cost given that such variables as average salary and labor productivity are included in these analyses.

Importance

Two conditions must be satisfied for a variable to transmit the Program's influence on total cost. First, the Program must influence the variable in the appropriate direction. For example, to reduce cost through labor productivity the Program must have a positive effect on the latter variable. Second, the variable must impact cost. Continuing with the example, even if the Program has a positive effect on labor productivity, it will not reduce cost through this variable unless labor productivity has a negative influence on cost.

The productivity and resource usage analyses, which determine the Program's influence on these variables, are directed toward the first condition. These analyses address the second condition by determining the effects of the productivity and resource usage variables on cost. Together these two types of analyses identify productivity and resource usage variables through which the Indiana Program influences cost.

Effects of Productivity and Resource Usage

As discussed, labor productivity is expected to have a strong negative impact on total cost. Since the Program is expected to have a positive effect on labor productivity, it is likely that labor productivity will be an important mechanism through which the Program influences cost. In contrast, because of the hospital's labor dominance, capital productivity is expected to have a much weaker negative effect on cost. In fact, its impact may be insignificant. Accordingly, despite the Program's expected positive influence on capital productivity, this variable is not likely to be a mechanism appreciably transmitting the Program's impact on cost.

Average salary is anticipated to have a strong positive impact on cost. Since the Program is expected to exert a negative influence on this variable, average salary is expected to be a major mechanism transmitting the Program's influence on cost.

The Indiana Program is expected to have an insignificant impact on capital intensity in the Tristate and Combined analyses. It is therefore unlikely that capital intensity will convey the Program's cost effect in these analyses. However, as a result of the Michigan program, hospitals in that state are likely to exhibit higher capital intensity than are Indiana hospitals. This capital intensity effect is expected to partially account for the cost differences between Indiana and Michigan hospitals, but it will be much smaller in magnitude than the transmitting effects of labor productivity and average salary.

Average salary and labor productivity -- the two variables likely to be primarily responsible for transmitting the Program's influence on cost -- are expected to be largely independent of each other. Actions by hospital administrators designed to influence one of these variables in a particular direction are not likely to have the reverse effect on the other variable. Such an effect is necessary if a single action by a hospital is to reduce cost through both average salary and labor productivity, since the former is expected to have a positive influence on cost and the latter a negative effect.

A firm stance designed to restrain wage increases is not likely by itself to produce an increase in labor productivity. Conversely, if hospital personnel are induced to increase their productivity levels, average salary is not likely to decline as a result, Similarly, changes in skill mix will usually drive these variables in the same direction rather than in opposite directions.

Since average salary and labor productivity are not proxies for each other, their simultaneous presence in the Step C analyses will not interfere with their strong effects on cost. By extension, this means that the Program's effects on these two variables are largely independent. In order to reduce cost through both average salary and labor productivity, the Indiana Program must induce hospital administrators to take different types of actions.

In summary, the following hypotheses will be tested in this area.

(11) Labor productivity will have a strong negative impact on total cost. Since the Indiana Program is expected to have a positive effect on labor productivity, this variable will be an important mechanism transmitting the Program's influence on cost.

(12) Capital productivity will have a weakly negative or insignificant influence on cost. Accordingly, although the

Program is expected to have a positive impact on capital productivity, this variable will not be a mechanism appreciably transmitting the Program's impact on cost.

(13) Average salary will have a strong positive impact on cost. Since the Indiana system is expected to have a negative influence on average salary, this variable will be an important mechanism transmitting its impact on cost.

(14) Capital intensity will have a positive effect on cost. The Indiana Program is expected to have an insignificant influence on this variable in the Tristate and Combined analyses, and therefore will not transmit the Program's cost impact in these analyses. Michigan hospitals are expected to display a higher capital intensity than are Indiana hospitals. Capital intensity will thus be partially responsible for the cost differences between Michigan and Indiana hospitals. However, this capital intensity effect will not be as large as the transmitting effects of labor productivity and average salary.

11.
Endogenous Variables

The construction and characteristics of the Segment I endogenous variables are described in this chapter in the same order as they are addressed in Chapter 10. Accordingly, the cost variables are discussed first, followed by the productivity and resource usage measures.

The data source for the Segment I endogenous variables is the Medicare Cost Reports (MCRs), which are described in Chapter 7. Important correlations among these variables are discussed in this chapter, while the means and standard deviations of these variables are displayed in Appendix B.

Total Cost

The total cost measure is defined as cost per case. Except for ECF and newborn cases, all hospital cases are included in its denominator. All hospital expenses are included in the numerator except for professional component expenses and non-patient care costs. The former are fees paid to physicians (as defined by Part B of the Medicare program). Examples of the latter are expenses for gift and flower shops.

Total cost increased rapidly during the study years. Its mean is $757 in 1973 and $442 in 1968. Its average percentage increase is 72%.[1] The variation in total cost is substantial; its coefficient of variation in 1973 is .37. Sizeable variation also characterizes the total cost percentage change variable, with the coefficient of variation for this measure equalling .48.

Departmental Cost

Three departmental costs are analyzed in this study -- nursing cost, administrative/hotel cost, and ancillary cost. Each variable is

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[1] Like the mean in any study year, the mean percentage change is defined as the sum of study hospital values for the percentage change variable divided by the number of hospitals. This statistic will be similar to, but not necessarily the same as, the result obtained by subtracting the 1968 mean from the 1973 mean and dividing by the former. This point is illustrated here since the latter statistic is 71% while the mean percentage increase is 72%.

defined as departmental expenses per case. Table 11-1 displays the units whose expenses comprise the numerators of these variables. As with total cost, professional component and non-patient care expenses are excluded.

Table 11-1

COMPONENTS OF DEPARTMENTAL COST VARIABLES

Nursing Cost	Administrative/ Hotel Cost	Ancillary Cost
Medical/Surgical	General Administration	Laboratory
Pediatrics	Nursing Service Adminis.	Radiology
Obstetrics/Gynecology	Employee Fringe Benefits	EKG
Intensive Care	Personnel	Electroencephalography
Coronary Care	Dietary	Surgery
Psychiatric	Cafeteria	Recovery Room
Other Specialized Care	Laundry	Anesthesiology
	Housekeeping	Labor/Delivery
	Plant Operation	Blood Bank
	Central Supply	Intravenous Therapy
	Pharmacy	Inhalation Therapy
	Medical Records	Physical Therapy
	Library	Occupational Therapy
	Social Services	Speech Therapy
	Other Services	Other Ancillary

These departmental cost measures are relatively immune to variations in hospital accounting practices. This would not be the case if non-aggregate departmental cost measures were used. For example, in the ancillary area some hospitals include EKG expenses in laboratory costs; others place such expenses in radiology costs; and others classify EKG as a separate cost center. This type of accounting variation would affect most strongly an EKG cost measure, but it would also influence a laboratory or radiology cost measure. In contrast, the ancillary cost variable is not affected by this accounting variation because it includes all three units to which EKG expenses may be allocated.

The departmental costs rose markedly during the study period. The increase was sharpest for ancillary cost, whose mean percentage increase is 95%. Average inflation was lowest for nursing cost, 55%; and intermediate for administrative/hotel cost, 69%.

Administrative/hotel cost represents almost one half of total cost, as shown in Table 11-2. In 1973 nursing cost and ancillary cost are almost equal, each constituting about 25% of total cost. In 1968 the relative magnitude of nursing cost is higher while that of ancillary cost is lower, reflecting the greater percentage increase in the latter during the study years.

Table 11-2

DEPARTMENTAL COSTS AS A PERCENTAGE OF TOTAL COST

	Percentage of Total Cost		
Departmental Cost	1973	1968	$ Increase 1968-1973
Nursing Cost	25%	28%	21%
Admin./Hotel Cost	44%	45%	43%
Ancillary Cost	24%	21%	27%

Similar findings arise from a comparison of the dollar increases in total and departmental costs during the study years (i.e., not the percentage increases in these costs, but rather their absolute dollar increases). In dollar terms administrative/hotel cost accounted for 43% of the increase in total cost. Ancillary cost was responsible for a greater fraction of the total cost increase than was nursing cost, but the difference is not as great as might be suggested by comparing the percentage changes in these costs. The dollar increase in ancillary cost constituted 27% of the dollar increase in total cost, while the corresponding statistic for nursing cost is 21%.

As expected, total cost is strongly associated with the three departmental costs. As indicated in Table 11-3, its highest correlation in 1973 is with administrative/hotel cost, .94. Its correlations with the other two departmental costs are similar -- .92 with nursing cost and .87 with ancillary cost. The correlations among the three departmental costs are also high, approximating .80. In 1968 the associations among these four cost variables are similar, although somewhat lower.

Table 11-3

CORRELATIONS AMONG 1973 DEPARTMENTAL AND TOTAL COSTS

Departmental Cost	Total Cost	Nursing Cost	Admin./ Hotel Cost
Nursing Cost	.92		
Admin./Hotel Cost	.94	.82	
Ancillary Cost	.87	.76	.78

As displayed in Table 11-4, the percentage change in total cost is highly correlated with the percentage change in administrative/hotel cost, .87. Its correlations with the percentage changes in the other departmental costs are again similar -- .70 for nursing cost and .64 for ancillary cost -- but in this instance distinctly lower than its correlation with the percentage change in administrative/hotel cost. The correlations among the departmental cost percentage change variables are substantially lower than those among the 1973 departmental costs. Even so, the lowest such correlation, which involves the nursing and ancillary cost percentage change variables, is easily significant at the .001 level.

Table 11-4

CORRELATIONS AMONG PERCENTAGE CHANGES IN DEPARTMENTAL AND TOTAL COSTS

Departmental Cost	Total Cost	Nursing Cost	Admin./ Hotel Cost
Nursing Cost	.70		
Admin./Hotel Cost	.87	.54	
Ancillary Cost	.64	.32	.48

Productivity

Labor productivity is defined as cases per FTE and capital productivity as cases per bed. Cases and beds have been previously defined. FTEs equal the number of full-time equivalent personnel employed by the hospital. As is substantively preferable, unpaid FTEs are excluded,

but this exclusion makes little difference since unpaid FTEs (as reported in the MCRs) equal less than 1% of paid FTEs.

In 1973 average labor productivity for the study hospitals is 17.2 while average capital productivity is 35.9. The variation in the two productivity measures is moderate, with the coefficients of variation equalling .25 for labor productivity and .19 for capital productivity. Neither variable changed substantially during the study years. Labor productivity declined by an average of about 10%, while capital productivity decreased by an average of less than 1%.

As expected, the association between labor productivity and capital productivity is sizeable, but not extremely high. The correlation between these variables approximates .50 in both study years, so that their degree of common variation is 25%. The correlation between the percentage changes in these variables is similar, .43.

Resource Usage

Segment I includes three resource usage variables. They are: average salary, defined as payroll divided by FTEs; capital intensity, which equals capital assets per bed; and payroll/cost, which equals payroll divided by total hospital expenses.

Payroll is defined as all salaries and wages paid by the hospital with the exception of those included in professional component expenses or allocated to non-patient care cost centers. Capital assets equals the net or depreciated value of the entire hospital plant and its equipment. This measure suffers to some extent from variation in depreciation practices among hospitals, and from the fact that accepted schedules of depreciation may not coincide with changes in market value. Nonetheless, the net value of plant and equipment is the best available estimate of the value of hospital inputs.[2]

In 1973 the mean of average salary for the study hospitals was $7,100. Mean capital intensity approximated $25,000. Average salary increased markedly during the study years, although not to the same extent as total or departmental costs. The mean increase in this variable was 40%. The rise in capital intensity was higher, averaging 64%. In contrast, payroll/cost decreased by 8% during the study years. It averaged .63 in 1968 and .58 in 1973. Thus, as an approximation labor expenses comprised 60% of total hospital expenses during the study period.

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[2] Variables similar to this study's capital intensity measure have been used effectively by Salkever and Bice (1978) and Davis (1974).

As expected, capital intensity exhibits the most variation among the Segment I endogenous variables. In 1973 its coefficient of variation is .54. The variation in average salary approximates that in the productivity measures. Its coefficient of variation is .19. In contrast, but as anticipated, variation in payroll/cost is the lowest among the Segment I endogenous variables, with its coefficient of variation equalling .08.

In 1973 the correlation between labor productivity and average salary is negative but modest, -.25. In 1968 this association is insignificant. The correlation between the percentage changes in these variables is stronger, but positive, .51. These findings are supportive of the thesis developed in Chapter 10 that these variables constitute different mechanisms for influencing cost. At a minimum it is clear that the relationship between average salary and labor productivity is not strongly negative, which would be required for these variables to have competing rather than synergistic effects on cost.

In 1973 the correlation between capital intensity and average salary is significant but moderate in magnitude, .30. This association is insignificant in 1968 as is the correlation between the percentage changes in these variables. The correlations between capital intensity and labor productivity are negative, but also modest. Therefore, as expected, the correlation pattern of capital intensity confirms that it is a variable largely independent of average salary and labor productivity. Similarly, capital productivity is not appreciably associated with either average salary or capital intensity, although as discussed earlier the correlation between the two productivity measures is substantial.

12.
Effects on Total and Departmental Costs

This chapter discusses the total and departmental cost analyses which were conducted to test the hypotheses developed for the cost variables in Chapter 10. In this and later chapters describing regression results, each section is devoted to a set of analyses. In this chapter the first section addresses the total cost analyses and the second the departmental cost analyses.

Each of these sections has two subsections. The first discusses the overall results of the analyses, beginning with a description of the analysis findings and concluding with an interpretation of those findings. This subsection concentrates on the percentage impact results, but also discusses the dollar impact findings as appropriate.

The second subsection discusses the detailed findings of the analyses. It describes the predictive power of the regression equations, the degree of collinearity in those equations, the significance levels of the Indiana Program's effects, and the other determinants of the endogenous variable.

Total Cost

Overall Results

Regression Findings -- It was hypothesized in Chapter 10 that the Indiana Program would have a marked negative influence on total cost in 1973 and a modest negative influence on this variable in 1968. It was correspondingly anticipated that the Program would have a negative impact on the percentage change in total cost. In addition, the Program's effects on total cost were expected to be similar in the Michigan and Tristate analyses.

These hypotheses are largely supported by the findings. In the Combined analyses the conformance is precise. As shown in Table 12-1, the Program has a -10% impact on total cost in 1973, while its influence in 1968 is smaller but still significant, -4%. Accordingly, the Program has a strong negative effect on the percentage change in total cost

between 1968 and 1973. The findings in the two intermediate years are consistent with these results. In 1970 the Program's impact is -5%; in 1972 it is -10%.[1]

Table 12-1

INDIANA PROGRAM'S INFLUENCE ON TOTAL COST
IN THE COMBINED ANALYSES

	Percentage Impact	Dollar Impact
1973	-10%	-$80
1972	-10%	-$69
1970	-5%	-$29
1968	-4%	-$16
Change between 1968 and 1973	-19%	-$65

The Program's influence on cost is also sizeable in dollar terms. As indicated in Table 12-1, the Indiana system lowers hospital expenses by $80 per case in 1973, and by $69 per case in 1972. Its 1970 and 1968 dollar savings are respectively $29 and $16 per case.[2] As an

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[1] As an approximation, these percentage impact findings show the percentage differences in total cost between Indiana and control hospitals during the time periods indicated. For example, the 1973 result indicates that the costs of Indiana hospitals were 10% lower than the costs of control hospitals in that year, taking into account the effects of exogenous variables. The percentage differences represent the Program's influence for the reasons discussed in Chapter 4.

[2] These dollar impact results (which are shown directly by the Program's regression coefficients) indicate the dollar differences in total cost between Indiana and control hospitals during the time periods analyzed. As an illustration, the 1973 finding denotes that cost per case was $80 lower in Indiana hospitals than in control hospitals during that year, taking into account the effects of exogenous variables. Like the percentage differences, the dollar differences are due to the impact of the Indiana Program.

approximation, the Program reduces by $65 per case the increase in hospital expenses between 1968 and 1973.[3]

As indicated in Table 12-2, the Tristate findings are also congruent with the Chapter 10 hypotheses except for 1970 when the Program's influence is insignificant. In these analyses the Program's effects on total cost are -10% in 1973 and -7% in 1972; its impact in 1968 is -6%; and its influence on the percentage change in total cost is -11%.

The Michigan findings are the least consistent with the hypotheses, but even here the divergence is modest. As expected, in these analyses the Program exerts a negative influence on total cost in the later study years: -7% in 1973 and -9% in 1972. Further, the Program has a sizeable negative impact on the percentage change in total cost, -22%. However, in both 1970 and 1968 the Program's influence on cost is insignificant.

In 1973 the Program's impact on cost is greater in the Tristate analyses than in the Michigan analyses: -10% versus -7%. In 1972 the reverse is true. The Program's impact in the Michigan analyses is -9% compared to -7% in the Tristate analyses. In the two later study years the Program's average impact is thus almost equal in the Michigan and Tristate analyses: -8% in the former and -8.5% in the latter.

In 1970 the Program's impact is insignificant in both analyses. In contrast, the Program's effect in 1968 is distinctly stronger in the Tristate analyses. In those comparisons it has a -6% impact, while its effect is insignificant in the Michigan analyses. Partially as a result, the Program has a much stronger impact on the percentage change in total cost in the Michigan analyses than in the Tristate comparisons: -22% compared to -11%.

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[3] Unlike the other dollar impact results, this finding cannot be taken directly from the regression analyses. Rather, it is an approximation based on the analysis results, which is calculated in the following way.

If all study hospitals had not been operating under the Indiana Program in 1968, the analyses indicate that their average cost would have been $432, taking into account the effects of other variables. Further, if all study hospitals had not been functioning under the Indiana Program between 1968 and 1973, their average percentage increase in cost between these years would have been 79.4%, again taking into account the influence of other variables. Accordingly, the average dollar increase in costs in such hospitals during this period would have been the 1968 average cost of $432 multiplied by 79.4%, or $343.

The analyses also show that the Indiana Program reduces cost inflation between 1968 and 1973 by 19%. Thus, as an approximation, the Program's impact on the dollar increase in costs is the dollar increase of $343 multiplied by 19%, or $65.

Table 12-2

INDIANA PROGRAM'S IMPACT ON TOTAL COST
IN THE MICHIGAN AND TRISTATE ANALYSES

	MICHIGAN	TRISTATE
1973	-7%	-10%
1972	-9%	-7%
1970	0*	0
1968	0	-6%
% Δ '68-'73	-22%	-11%

*Consistent with the earlier discussions, if the Program's impact is not significant at least at the .05 level, it is reported as a zero in this and similar tables in Section IV.

While there are specific differences between the Michigan and Tristate findings, the dominant result is the substantial similarity between these findings. In both analyses the Program exerts its greatest effect in the later study years. In the two comparisons the magnitude of the Program's influence is similar in the later years. In both analyses the Program exerts a negative influence on the percentage change in total cost.

As discussed in Chapter 10, cost per case is superior to cost per patient day as the main dependent variable of the study. Even so, the Program's impact on cost per patient day was determined in a supplementary regression analysis whose results are displayed in Table 12-3.

As expected, the cost per patient day results are highly similar to the cost per case findings. In the Combined analyses the Program's percentage effects on cost per case and cost per patient day are the same in the last two study years. Its percentage influence on cost per patient day is modestly higher in the two early study years, while its percentage impact on the percentage change in cost per case is slightly greater.

The cost per case and cost per patient day results also resemble each other in the Michigan and Tristate analyses, albeit not quite to the

same extent as in the Combined findings. The only important difference between the two sets of cost results occurs in the 1970 Michigan analyses. In that year the Indiana system has a -6% impact on cost per patient day, but an insignificant effect on cost per case.

Table 12-3

IMPACT OF INDIANA PROGRAM ON COST PER PATIENT DAY

	COMBINED	MICHIGAN	TRISTATE
1973	-10%	-8%	-9%
1972	-10%	-10%	-6%
1970	-6%	-6%	0
1968	-5%	0	-6%
% Δ '68-'73	-17%	-20%	-12%

Time Trend Findings -- A time trend analysis was performed to further investigate the Program's effects on hospital costs. It compares the average costs of study hospitals in Indiana and the control states from 1958 through 1976, i.e., before, during, and after the main study time period. AHA Survey data was used for this purpose because unlike MCR data, it is available for years prior to 1966.

Among the 246 Segment I hospitals, 174 institutions (55 Indiana hospitals and 119 control hospitals) have total cost data in the AHA Survey for five important years -- 1960, 1964, 1968, 1973, and 1975. These institutions, termed the time trend hospitals, were used as the subsample for the time trend analysis.

Comparison tests analogous to those described in Chapter 5 were employed to examine the degree of similarity between the time trend hospitals and the non-time trend study hospitals. These tests, whose detailed results are displayed in Appendix B, indicate that the characteristics of these two sets of hospitals are almost identical. In Test B there is only one significant difference between the time trend and non-time trend hospitals in terms of the 56 Segment I variables. In Test C there are no significant differences. The time trend subsample is thus highly comparable to the main study sample.

While the time trend analyses provide valuable insights, their findings must not be overdrawn since this type of analysis is much less accurate than regression analysis. However, these analyses are

founded on a sounder methodologic base than are statewide time trend analyses. As discussed above, the time trend subsample closely resembles the main study sample. This means that the Indiana and control hospitals in the time trend subsample are similar in terms of exogenous variables. This similarity is not perfect, which is one reason necessitating the use of regression techniques in this study. Even so, it is sufficiently close that these time trend findings are much less distorted by exogenous variable differences than would be, for example, a comparison over time of the average costs of all Indiana and Michigan hospitals, or all Indiana and Ohio hospitals.

Table 12-4 shows average total cost (i.e., average cost per case) for the Indiana and control hospitals. It also indicates the dollar and percentage differences between the Indiana and control means. The dollar difference is calculated by subtracting the control mean from the Indiana mean; the percentage difference equals the dollar difference divided by the control mean. Negative dollar and percentage differences indicate that Indiana hospital costs are lower than control hospital costs. Positive values for these statistics have the reverse connotation.

Table 12-4

TIME TREND FINDINGS

	Average Indiana Hospital Cost	Average Control Hospital Cost	Dollar Difference	Percentage Difference
1958	$181	$191	-$10	- 5%
1959	199	209	- 10	- 5
1960	205	215	- 10	- 5
1961	221	235	- 14	- 6
1962	225	253	- 28	-11
1963	243	266	- 23	- 9
1964	254	281	- 27	-10
1965	280	305	- 25	- 8
1966	307	331	- 24	- 7
1967	338	387	- 49	-13
1968	398	440	- 42	-10
1970	503	576	- 73	-13
1972	603	705	-102	-14
1973	644	759	-115	-15
1974	698	868	-170	-20
1975	827	983	-156	-16
1976	953	1149	-196	-17

The negative dollar difference rises steadily during the main study years, increasing from -$42 in 1968 to -$115 in 1973. Similarly, the percentage difference increases from -10% in the former year to -15% in the latter year. In each main study year the percentage difference obtained in this analysis exceeds the percentage impact result derived from regression analysis (shown in Table 12-1) by an absolute amount of approximately 5%. Specifically, the differences are -6% in 1968; -8% in 1970; -4% in 1972; and -5% in 1973.

The Indiana Program was initiated in the latter part of 1960. In that year and in the two preceding years, the dollar difference is small, but negative, -$10. Similarly, in all three years the percentage difference is low, -5%. Given that the percentage difference in this analysis consistently exceeds the percentage impact result by about 5% in the main study years, it is unlikely that regression analysis would demonstrate a significant difference between Indiana and control hospital costs in 1958-60, the three years prior to the Program's implementation. At a minimum it is clear from Table 12-4 that the dollar differences in these years are far lower than those in the main study years.

In 1961, the first year after the Program was established, the percentage difference is approximately the same as in the earlier years, -6%. However, in the next year it rises sharply to -11%. This statistic is somewhat lower in the ensuing four years, ranging from -10% in 1964 to -7% in 1966.[4] Both the dollar and percentage differences increase markedly in 1967, rising to -$49 and -13% respectively. The percentage difference is thus greater during 1962-67 than during the period preceding the Program's inception. In 1962-67 the average percentage difference is -10% compared to -5% in 1958-60. Conversely, the percentage difference is smaller during the 1962-67 span than during the main study years, when it averages -13%.

The dollar difference is much higher in 1974-76 than in the main study years. It rises sharply to -$170 in 1974; decreases modestly to -$156 in 1975; and increases again to -$196 in 1976. The percentage difference exhibits a similar undulating pattern. Even so, it is higher in each of these years than in any of the main study years. During 1974-76 this statistic averages -18% as compared to -13% during the main study period.

In their time trend analyses Dowling et al. (1976a and 1976b) estimate the impact of the New York program by employing a seven-step technique which focuses on the changes in the cost inflation rates of New York and control hospitals. The first step is to calculate the average

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[4] The 1966 result is consistent with the regression findings of Pauly and Drake (1970), which are described in Chapter 10.

annual inflation rate for New York hospitals during the period before program implementation. The second step is to determine the average annual inflation rate for these hospitals during the years after program implementation. The third and fourth steps are to calculate the corresponding inflation rates for the control hospitals.

The fifth and sixth steps are to determine for New York and control hospitals respectively, the changes in the average inflation rates that occurred at the time of program implementation, i.e., to calculate for each set of hospitals the difference between the "before" and "after" inflation rates. The final step is to subtract the change in the control hospital inflation rate from the change in the New York hospital inflation rate. According to this technique, this difference represents the impact of the New York program.

Using this technique (but applying it only to nonprofit hospitals since there were relatively few for-profit hospitals in the control group), Dowling determined that the New York system decreased cost per case by an average of 2.4% per year during the five years between 1969 and 1974. He further found that the system reduced cost per case adjusted for changes in prices and outpatient intensity by an average of 2.8% per year during the same time period.[5]

This technique has significant methodologic problems. First, its results are not based on regression analysis. Hence, like the time trend findings of this study, its findings must be regarded more cautiously than regression results. Second, as discussed in Chapter 4, the annual rate of hospital cost inflation is not constant in the "before" and "after" time periods, as is assumed by the Dowling technique. In actual fact, there is sizeable variation in the inflation rate from year to year.

Third, the substantive basis of the Dowling technique is somewhat tenuous. On the one hand, if the experimental and control hospitals are similar, there is no need to employ this technique whose assumptions about hospital behavior over time are more extreme than those of the analyses used in this study. On the other hand, if the experimental and control hospitals are not similar and exhibit distinctly

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[5] Adjusting for changes in outpatient intensity is consistent with the methodology of this study. However, adjusting for changes in prices is not. The dominant factor in the Dowling price adjustment is changes in wage level. As discussed elsewhere in this report, the wage rates of many hospital employees can be influenced by the hospital administrative staff. Further, hospitals can readily exert such influence within five years -- the "after" time period in the Dowling study. Accordingly, hospital wage level should be considered an endogenous variable, not an exogenous factor.

different "before" inflation rates, it is not clear on substantive grounds that the difference in the experimental and control inflation rates would have persisted over time if the program had not been implemented.

Fourth, in the Dowling study only a single observation (the change between 1968 and 1969) is used to calculate the "before" inflation rates for New York and control hospitals. As a consequence, these rates are highly sensitive to idiosyncratic disturbances and thus may not reflect the central tendency of hospital cost behavior over time. Illustrating this point, the "before" inflation rate for the Chicago control hospitals in the Dowling study is in fact negative. Thus, built into the Dowling results is the expectation that Chicago hospital costs would continue to decline during the "after" time period -- an expectation clearly contradictory to hospital cost experience in this country.

Despite these methodologic problems, it is nonetheless instructive to apply the Dowling technique to the Indiana data, since this technique is one approach through which the Indiana and New York findings can be directly compared. The results of this action are displayed in Table 12-5. As indicated there, the "before" inflation rates are similar for Indiana and control hospitals -- a finding consistent with the study methodology. Moreover, these inflation rates are based on two, rather than one, observations (the changes between 1958 and 1959 and between 1959 and 1960).

Table 12-5

COST IMPACT OF INDIANA PROGRAM
ACCORDING TO DOWLING TECHNIQUE

	Average Annual Inflation Rate 1958-1960	Average Annual Inflation Rate 1960-1976	Change in Inflation Rate	Difference Between Indiana and Control Changes in Inflation Rates
Indiana	6.6%	22.8%	16.2%	
				-4.7%
Control	6.3%	27.2%	20.9%	

The "after" inflation rates for Indiana and control hospitals are substantially different: 22.8% and 27.2% respectively. Consequently, the changes in the inflation rates are distinctly different for these hospitals -- 16.2% for Indiana hospitals and 20.9% for control hospitals. The difference between these changes in the inflation rates is -4.7%.

The conclusion of this analysis is thus that the Indiana Program reduced cost per case by an average of 4.7% per year during the 16 years between 1960 and 1976. Therefore, based on the Dowling technique, the cost impact of the Indiana Program is much larger than that of the New York system.

Interpretation -- The total cost findings in the regression analyses are of critical importance. They indicate that the Indiana Program has achieved its main objective: It has a substantial negative influence on hospital cost. This effect is stronger in the later study years than in the early years.

Since the Michigan and Tristate results are similar, the Combined findings represent the best summary of these analyses. In the Combined analyses the Program's impact on cost equals -10% in 1973 and -4% in 1968; its effect on the percentage change in cost is -19%. These results show that the Indiana Program has achieved important cost savings. Given the size of the hospital industry, a consistent saving of 5% is noteworthy; a saving of 10% is major.

In 1973 the Program lowers hospital expenses by $80 per case. Its 1968 dollar saving is $16 per case. It reduces the increase in hospital expenses between 1968 and 1973 by $65 per case. The 1973 saving of $80 per case is thus composed of two unequal components: the saving of $16 per case already attained by 1968 and the $65 reduction in the cost increase per case between 1968 and 1973.

While there are specific differences between the Michigan and Tristate findings, the central result is the strong resemblance between these findings. This shows that the Indiana Program has been as effective in restraining cost compared to the Type II Michigan environment as compared to the Type I Tristate environment. This study's Type II environment thus has been no more successful in reducing cost than has its Type I environment. While this finding was expected, it nonetheless points up the general premise that planning or capital expenditures regulation is not likely by itself to be an effective mechanism for controlling hospital costs.

As noted, the analyses show that the Indiana Program's negative influence on cost accelerated during the ESP years. It still remains possible that ESP decreased the Program's influence from what otherwise might have been the case. However, it is evident that at a minimum the effects of ESP did not overwhelm the Program's influence.

Three important conclusions emerge from the time trend analyses. First, Indiana and control hospital costs do not appear to be significantly different in 1958-60, the time period shortly before the Indiana Program's implementation. Second, while the Program's influence on cost seems insignificant in 1961, its cost impact appears to be negative in 1962-67, but not as strong as its influence during the main study years. Third, the Program's effect on cost appears greater during

1974-76 than during the main study period. Because of the rapid inflation in hospital costs, this is certainly true in terms of the Program's dollar impact. It is probably also true in terms of its percentage impact.

The regression findings clearly establish that the Program's influence on cost markedly increases between 1968 and 1973. The time trend analyses extend these findings by indicating that the Program's cost impact seems to have risen steadily since it first became apparent in the early 1960s. It is thus evident that the Program's ability to control hospital costs has progressively improved with the passage of time.

Detailed Findings

The predictive power of the total cost annual analyses is high, as displayed in Table 12-6. The R^2s range from .83 in the 1973 Michigan equation to .68 in the 1972 Tristate comparison. In the Combined analyses they approximate .75.

Collinearity involving the Indiana Program is moderate. The Program's covariance ratio ranges from .21 to .06, approximating the latter value in the Combined analyses. Overall collinearity in these equations is substantial, but not sufficiently high to interfere with their interpretability. The determinant ranges from .53 to .21.

In the Combined analyses the Program's effect is significant at the .001 level in the two later study years. It is significant at the .05 level in the early years, although only narrowly so in 1968. In the Tristate analyses the Program's impact is significant at the .001 level in 1973, at the .01 level in 1968, and almost at that level in 1972. In 1970 its impact is negative, but is only significant at the .10 level. In the Michigan comparisons the Program's influence is significant at the .01 level in both 1973 and 1972. In 1970 its effect is negative and approaches significance at the .10 level, while in 1968 its impact is thoroughly insignificant.

Table 12-6

ANNUAL ANALYSES OF TOTAL COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-80×10^{0}	-69×10^{0}	-29×10^{0}	-16×10^{0}	-58×10^{0}	-63×10^{0}	-20×10^{0}	-12×10^{-1}	-73×10^{0}	-45×10^{0}	-19×10^{0}	-25×10^{0}
t-value	-4.32	-3.68	-2.01	-1.67	-2.44	-2.81	-1.09	-0.10	-3.81	-2.30	-1.38	-2.57
% impact	-10.2	-9.8	-5.1	-3.7	-7.1	-8.6	-3.4	-0.3	-10.1	-6.9	-3.5	-5.7
covariance	0.06	0.06	0.07	0.06	0.21	0.21	0.21	0.19	0.15	0.07	0.07	0.10
Length of Stay												
coefficient	91×10^{0}	92×10^{0}	67×10^{0}	47×10^{0}	99×10^{0}	87×10^{0}	76×10^{0}	55×10^{0}	75×10^{0}	85×10^{0}	55×10^{0}	40×10^{0}
t-value	11.75	11.88	12.77	14.93	11.06	10.18	10.47	13.38	8.41	10.29	10.87	12.40
ECF Involvement												
coefficient	23×10^{1}	17×10^{1}	12×10^{1}	14×10^{1}	23×10^{1}	12×10^{1}	11×10^{1}	17×10^{1}	20×10^{1}	20×10^{1}	11×10^{1}	14×10^{1}
t-value	5.93	4.62	3.91	5.67	4.18	2.51	2.50	4.28	4.49	4.33	3.46	5.83
Emergency/Outpatient												
coefficient	80×10^{1}	45×10^{1}	45×10^{1}	34×10^{1}	13×10^{2}	95×10^{1}	11×10^{2}	52×10^{1}	43×10^{1}			38×10^{1}
t-value	4.46	2.22	2.58	2.38	5.53	3.32	4.28	2.85	1.91			2.40
Medical Education												
coefficient	33×10^{2}	32×10^{2}	27×10^{2}	18×10^{2}	31×10^{2}	31×10^{2}	23×10^{2}	18×10^{2}	33×10^{2}	30×10^{2}	28×10^{2}	14×10^{2}
t-value	10.54	9.06	8.94	8.73	9.31	8.76	7.01	7.50	5.09	4.82	5.95	4.64
Fiscal Year												
coefficient	99×10^{-1}	67×10^{-1}	86×10^{-1}	65×10^{-1}	14×10^{0}	11×10^{0}	14×10^{0}	81×10^{-1}	58×10^{-1}			61×10^{-1}
t-value	3.48	2.31	3.83	4.33	3.88	3.12	4.59	3.98	1.77			3.70
MD Concentration												
coefficient	76×10^{-2}	59×10^{-2}							98×10^{-2}	89×10^{-2}		
t-value	2.59	1.96							2.31	2.10		
Income												
coefficient	27×10^{-3}	22×10^{-3}	29×10^{-3}	28×10^{-3}	34×10^{-3}	21×10^{-3}	31×10^{-3}	33×10^{-3}	21×10^{-3}	29×10^{-3}	23×10^{-3}	24×10^{-3}
t-value	3.49	2.78	4.98	7.39	3.43	2.14	4.09	6.33	2.44	3.50	3.77	5.86
White Population												
coefficient	-50×10^{1}	-43×10^{1}	-44×10^{1}	-19×10^{1}	-63×10^{1}	-64×10^{1}	-42×10^{1}	-16×10^{1}	-52×10^{1}		-60×10^{1}	-36×10^{1}
t-value	-2.93	-2.48	-3.66	-2.30	-3.34	-3.47	-2.99	-1.68	-2.24		-3.75	-3.22
R^2	0.78	0.75	0.73	0.75	0.83	0.81	0.78	0.80	0.69	0.68	0.70	0.74
Determinant	0.28	0.29	0.43	0.47	0.26	0.25	0.29	0.34	0.21	0.51	0.53	0.48
Constant	59×10^{0}	35×10^{0}	71×10^{0}	-12×10^{1}	18×10^{0}	25×10^{1}	-13×10^{1}	-29×10^{1}	30×10^{1}	-35×10^{1}	44×10^{1}	14×10^{1}

Length of stay,[6] medical education involvement, and ECF involvement have strong positive effects on total cost in all the annual equations, although the influence of the latter variable is not as strong as the effects of the former two variables. Emergency/outpatient involvement and fiscal year are also positive determinants of total cost; their effects are significant in all but the middle two years in the Tristate analyses.

Among the local exogenous variables, income level[6] has the strongest impact on total cost. It has a positive influence in all these equations. White population has a consistent negative impact on total cost. The remaining determinant is physician concentration, which has a positive effect in the later study years in the Combined and Tristate analyses.

As displayed in Table 12-7, the predictive power of the total cost percentage change analyses is substantial, although not as high as that of the annual analyses. The R^2 ranges from .64 in the Michigan equation to .45 in the Tristate comparison, equalling .56 in the Combined analysis.

Collinearity involving the Indiana Program is low. The Program's covariance ratio ranges from .05 in the Combined equation to .12 in the Tristate comparison. Overall collinearity is moderate with the determinant never lower than .51.

The Program's impact on the percentage change in total cost is significant at the .001 level in the Combined and Michigan equations. It is solidly significant at the .05 level in the Tristate comparison.

Analogous to the annual analyses, the percentage changes in length of stay,[7] ECF involvement, and emergency/outpatient involvement have strong positive effects on the percentage change in total cost. Nonprofit control,[7] which has a negative effect, is also a significant determinant in all three equations. Consistent with the annual analyses, income level[7] and white population have negative effects in the

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[6] As discussed in Chapter 6, from a time period perspective, two types of independent variables are used in the annual analyses. The first is variables measured in the same year as the dependent variable. The second is variables measured in the only year for which data was available during the study period. Length of stay and income level respectively are examples of these two types of variables.

[7] From a time period perspective, three types of measures are employed as independent variables in the percentage change analyses. The first is percentage change variables calculated across the same time period as the dependent variable. The second is variables measured in 1968. The third is variables measured in the only year for which data is available during the study period. Exemplifying the three types of variables are the percentage change in length of stay, nonprofit control, and income level respectively.

Combined and Michigan equations, and physician concentration has a positive impact in the Tristate comparison.

Table 12-7

PERCENTAGE CHANGE ANALYSES OF TOTAL COST

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-15×10^{-2}	-19×10^{-2}	-78×10^{-3}
t-value	-4.59	-5.18	-2.08
% impact	-18.9	-21.6	-11.2
covariance	0.05	0.07	0.12
% Δ Length of Stay			
coefficient	18×10^{-1}	18×10^{-1}	16×10^{-1}
t-value	14.53	13.25	10.14
% Δ ECF Involvement			
coefficient	10×10^{-3}	90×10^{-4}	11×10^{-3}
t-value	6.45	5.08	5.03
% Δ Emergency/Outpatient			
coefficient	12×10^{-2}	12×10^{-2}	63×10^{-3}
t-value	4.81	4.70	2.02
Nonprofit Control			
coefficient	-10×10^{-2}	-11×10^{-2}	-97×10^{-3}
t-value	-3.12	-2.87	-2.51
MD Concentration			
coefficient			14×10^{-4}
t-value			1.74
Income			
coefficient	-27×10^{-6}	-40×10^{-6}	
t-value	-2.18	-2.66	
White Population			
coefficient	-84×10^{-2}	-97×10^{-2}	
t-value	-3.11	-3.38	
R^2	0.56	0.64	0.45
Determinant	0.53	0.51	0.68
Constant	19×10^{-1}	22×10^{-1}	70×10^{-2}

The annual and percentage change analyses of cost per patient day are displayed in Tables 12-8 and 12-9 respectively. The findings of these analyses resemble the cost per case results. As expected, the most striking differences relate to length of stay. This variable has a strong positive impact on cost per case as does the percentage change in this variable on the percentage change in cost per case. In contrast, length of stay generally has an insignificant influence on

Table 12-8

ANNUAL ANALYSES OF COST PER PATIENT DAY

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-11×10^{0}	-88×10^{-1}	-42×10^{-1}	-26×10^{-1}	-86×10^{-1}	-91×10^{-1}	-42×10^{-1}	-16×10^{-1}	-91×10^{-1}	-55×10^{-1}	-27×10^{-1}	-35×10^{-1}
t-value	-4.84	-4.28	-2.49	-2.37	-3.44	-3.78	-2.12	-1.22	-3.63	-2.46	-1.50	-2.79
% impact	-10.1	-9.5	-5.7	-4.7	-8.3	-9.6	-5.6	-2.8	-9.2	-6.4	-3.9	-6.4
covariance	0.06	0.06	0.07	0.06	0.18	0.21	0.21	0.13	0.12	0.06	0.07	0.10
Length of Stay												
coefficient				-76×10^{-2}					-31×10^{-1}		-19×10^{-1}	-13×10^{-1}
t-value				-2.09					-2.62		-2.77	-3.06
ECF Involvement												
coefficient	34×10^{0}	25×10^{0}	17×10^{0}	18×10^{0}	36×10^{0}	19×10^{0}	15×10^{0}	23×10^{0}	27×10^{0}	29×10^{0}	16×10^{0}	18×10^{0}
t-value	7.48	6.26	4.58	6.42	6.07	3.88	3.07	5.45	4.63	5.51	3.87	5.67
Emergency/Outpatient												
coefficient	88×10^{0}	44×10^{0}	37×10^{0}	41×10^{0}	14×10^{1}	10×10^{1}	11×10^{1}	50×10^{0}				45×10^{0}
t-value	4.20	1.99	1.84	2.55	5.56	3.27	4.10	2.67				2.14
Medical Education												
coefficient	31×10^{1}	29×10^{1}	25×10^{1}	16×10^{1}	26×10^{1}	26×10^{1}	21×10^{1}	15×10^{1}	40×10^{1}	31×10^{1}	30×10^{1}	13×10^{1}
t-value	8.80	7.58	7.18	6.55	7.45	6.88	5.88	6.32	4.71	4.35	4.77	3.34
Fiscal Year												
coefficient	13×10^{-1}	95×10^{-2}	12×10^{-1}	82×10^{-2}	19×10^{-1}	15×10^{-1}	17×10^{-1}	99×10^{-2}				79×10^{-2}
t-value	3.96	3.01	4.42	4.08	4.67	3.89	5.31	4.67				3.65
MD Concentration												
coefficient	11×10^{-2}	91×10^{-3}			88×10^{-3}	67×10^{-3}		52×10^{-3}	13×10^{-2}	11×10^{-2}		
t-value	3.29	2.92			2.43	1.97		2.26	2.41	2.49		
Income												
coefficient	54×10^{-4}	41×10^{-4}	46×10^{-4}	40×10^{-4}	55×10^{-4}	41×10^{-4}	49×10^{-4}	45×10^{-4}	37×10^{-4}	46×10^{-4}	36×10^{-4}	33×10^{-4}
t-value	6.48	4.76	6.85	9.12	5.06	3.85	6.07	8.86	3.32	4.73	4.51	6.05
White Population												
coefficient		-45×10^{0}	-39×10^{0}	-16×10^{0}	-39×10^{0}	-57×10^{0}	-40×10^{0}		-70×10^{0}		-70×10^{0}	-42×10^{0}
t-value		-2.56	-2.86	-1.71	-2.04	-3.13	-2.76		-2.25		-3.31	-2.89
R^2	0.60	0.58	0.57	0.59	0.72	0.70	0.68	0.68	0.44	0.42	0.43	0.52
Determinant	0.61	0.43	0.50	0.47	0.31	0.30	0.37	0.53	0.28	0.71	0.53	0.48
Constant	20×10^{0}	74×10^{0}	52×10^{0}	28×10^{0}	46×10^{0}	79×10^{0}	40×10^{0}	-50×10^{-1}	14×10^{1}	32×10^{0}	11×10^{1}	64×10^{0}

cost per patient day, or in a few equations, a moderate negative impact. Similarly, the percentage change in length of stay has an insignificant effect on the percentage change in cost per patient day.

Table 12-9

PERCENTAGE CHANGE ANALYSES OF COST PER PATIENT DAY

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-15×10^{-2}	-18×10^{-2}	-10×10^{-2}
t-value	-4.37	-4.80	-2.53
% impact	-17.2	-19.9	-12.1
covariance	0.03	0.07	0.03
% Δ ECF Involvement			
coefficient	13×10^{-3}	12×10^{-3}	13×10^{-3}
t-value	7.23	6.15	5.34
% Δ Emergency/Outpatient			
coefficient	12×10^{-2}	12×10^{-2}	87×10^{-3}
t-value	4.65	4.24	2.58
Medical Education			
coefficient	16×10^{-1}	14×10^{-1}	
t-value	2.21	1.94	
Nonprofit Control			
coefficient	-13×10^{-2}	-13×10^{-2}	-13×10^{-2}
t-value	-3.67	-3.33	-3.00
MD Concentration			
coefficient			16×10^{-4}
t-value			1.76
Income			
coefficient	-29×10^{-6}	-44×10^{-6}	
t-value	-2.11	-2.69	
White Population			
coefficient	-51×10^{-2}	-66×10^{-2}	
t-value	-1.73	-2.17	
R^2	0.33	0.40	0.23
Determinant	0.52	0.45	0.81
Constant	16×10^{-1}	19×10^{-1}	72×10^{-2}

Departmental Costs

Overall Results

Findings -- The Indiana Program was expected to have a strong negative influence on nursing cost in 1973, and a weaker negative effect on this variable in 1968. Accordingly, the Program was expected to have a negative impact on the percentage change in this variable.

The findings support these hypotheses. As shown in Table 12-10, in the Combined analyses the Program has a -15% impact on nursing cost in 1973, and a -8% effect on this variable in 1968. Further, the Program exerts a -19% influence on the percentage change in nursing cost. The Program's effects in 1972 and 1970 are similar to its 1973 impact, equalling -16% and -14% respectively.

Table 12-10

IMPACT OF INDIANA PROGRAM ON NURSING COST

	COMBINED	MICHIGAN	TRISTATE
1973	-15%	-16%	-13%
1972	-16%	-19%	-11%
1970	-14%	-17%	-8%
1968	-8%	-7%	-8%
% Δ '68-'73	-19%	-23%	0

The Michigan findings are comparable to the Combined results. In these analyses the Program's effect on 1973 nursing cost is -16%; its impact on 1968 nursing cost is -7%; and its effect on the percentage change in this variable is -23%. In the Tristate analyses the Program's impact is -13% in 1973, while its influence is -8% in 1968. Correspondingly, the Program's effects in 1972 and 1970 are -11% and -8% respectively. However, the percentage change result does not reflect the escalating pattern of the Program's influence demonstrated in the annual analyses. In the percentage change analyses the Program's impact is insignificant at the .05 level (although it is significant at the .10 level).

It was hypothesized that the Indiana Program would have a negative impact on administrative/hotel cost in 1973, and an insignificant or weakly negative effect on this variable in 1968. It was correspondingly anticipated that the Program's influence on the percentage change in this variable would be negative.

The results substantiate these hypotheses. As displayed in Table 12-11, in the Combined analyses the Program's impact on administrative/hotel cost is -7% in 1973; it is insignificant in 1968. The findings in the two middle years are supportive of these results. The Program's 1972 impact is -8%; its 1970 effect is insignificant. Consistent with the annual results, the Program's influence on the percentage change in this cost is -12%.

Table 12-11

IMPACT OF INDIANA PROGRAM ON
ADMINISTRATIVE/HOTEL COST

	COMBINED	MICHIGAN	TRISTATE
1973	-7%	-9%	-8%
1972	-8%	-10%	-6%
1970	0	0	0
1968	0	0	0
% Δ '68-'73	-12%	-15%	0

The findings of the annual analyses in the Michigan and Tristate comparisons are similar. In both comparisons the Program's influence is insignificant in 1968. In 1973 it has a -9% impact in the Michigan analyses and a -8% effect in the Tristate analyses. In the Michigan analyses the percentage change result is consistent with the annual findings, since the Program exerts a -15% influence on the percentage change in this variable. In contrast, but similar to the Tristate nursing cost results, the Program does not have a significant influence on the percentage change in administrative/hotel cost in the Tristate analyses.

The Program was hypothesized to have a negative effect on ancillary cost in 1973 and an insignificant or weakly negative impact on this factor in 1968. It was also expected to have a negative influence on the percentage change in this departmental cost.

These hypotheses are largely corroborated by the findings. As indicated in Table 12-12, in the Combined analyses the Program's impact on ancillary cost is -8% in 1968 and -12% in 1973. Its influence in the middle two years is also -12%. The results of the Michigan and Tristate analyses are similar in 1973. The Program's effect is -10%

in the former and -11% in the latter. Unlike the Combined findings, the Program's influence in 1968 is insignificant in the Michigan and Tristate comparisons.

Table 12-12

IMPACT OF INDIANA PROGRAM ON ANCILLARY COST

	COMBINED	MICHIGAN	TRISTATE
1973	-12%	-10%	-11%
1972	-12%	-8%	-9%
1970	-12%	-11%	0
1968	-8%	0	0
% Δ '68-'73	0	0	0

The inconsistency between the annual and percentage change results in the earlier Tristate analyses extends to all three analyses here. That is, despite the annual findings, the Program's impact on the percentage change in ancillary cost is insignificant. As is true for the earlier Tristate inconsistencies, the specific factors responsible for this divergence are not clear.

However, as a general rule the annual analyses are more accurate than the percentage change analyses because the dependent variable is less influenced by idiosyncratic variation.[8] Therefore, unless specific factors indicate the contrary, the annual results will be given precedence over the percentage change results when such an inconsistency occurs. As indicated above, no specific factors are evident in the departmental cost area. Accordingly, primary reliance is placed on the annual analyses which show without exception that the Program's influence on each departmental cost escalates during the study period.

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[8] To demonstrate this point, consider a 10% increase in 1973 ancillary cost produced by an idiosyncratic factor in a given hospital. If the percentage increase in ancillary cost between 1968 and 1973 would have been 100% in the absence of this factor, the percentage increase in ancillary cost will now equal 120%. Hence, the idiosyncratic factor produces a 20% increase in the percentage change in ancillary cost through only a 10% increase in 1973 ancillary cost.

In the annual analyses the Program's effects on the departmental costs are similar in the Michigan and Tristate comparisons. This is particularly true for the main Segment I years, 1973 and 1968. In these years the absolute difference between the Michigan and Tristate results is never higher than 1%, with the single exception being the 1973 nursing cost analyses, where the absolute difference is 3%.

It was expected that nursing cost would be the departmental cost most strongly impacted by the Program. It was also hypothesized that the Program would exert a greater influence on ancillary cost than on administrative/hotel cost.

Since the Michigan and Tristate results resemble each other, the Combined findings provide the best summary of the departmental cost analyses. These findings substantiate these hypotheses. In the later three study years the Program exerts a greater influence on nursing cost than on the other departmental costs. Illustrative in this regard is 1973 when the Program's impact on nursing cost is -15% compared to its -12% and -7% effects on ancillary and administrative/hotel costs respectively. In 1968 the Program's impact on nursing cost is greater than its insignificant effect on administrative/hotel cost, but is the same as its influence on ancillary cost, -8%. The percentage change analyses also demonstrate a greater impact by the Program on nursing cost.

In the Combined analyses the Program's impact on ancillary cost is greater than its influence on administrative/hotel cost in all study years. The 1973 and 1968 findings are cited above. The results in the middle two years are similar. In both these years the Program's impact on ancillary cost is -12%, whereas its influence on administrative/hotel cost is -8% in 1972 and insignificant in 1970. The percentage change results are reversed from the annual findings. The Program's impact on the percentage change in administrative/hotel cost is -12%, while its effect on the percentage change in ancillary cost is insignificant. However, as discussed earlier, in the departmental cost area precedence must be accorded the annual analyses. Accordingly, the overall finding is that the Program exerts a greater influence on ancillary cost than on administrative/hotel cost.

In relative terms the Indiana system thus has a greater impact on nursing cost than on ancillary cost, and a greater influence on the latter cost than on administrative/hotel cost. However, administrative/hotel cost is almost twice as large as each of the other costs. As a result, in 1973 the Program's dollar impact on administrative/hotel cost is approximately the same as its dollar impact on ancillary cost and only moderately lower than its dollar impact on nursing cost. These findings are displayed in Table 12-13.

As also indicated in the table, in 1968 the Program's dollar impact is moderately greater on nursing cost than on ancillary cost, even

though its percentage effects on these costs are equal. As described earlier, the Program's impact on administrative/hotel cost is insignificant in that year.

Table 12-13

DOLLAR IMPACT ON DEPARTMENTAL COSTS

	1973	1968
Nursing Cost	-$30	-$10
Ancillary Cost	-$23	-$8
Administrative/Hotel Cost	-$24	0

Interpretation -- The Indiana Program has a negative influence on all three departmental costs.[9] Like its impact on total cost, its influence on the departmental costs is greater in the later study years than in the early ones. The departmental cost analyses thus indicate that no major department is refractory to the Indiana Program's influence. Instead, the analyses show that the Program's impact is a hospital-wide effect, which strengthens the likelihood that the Indiana system will remain an important force in the future.

The departmental cost most strongly affected by the Program is nursing cost. This result occurs primarily because of this department's labor dominance and the hospital's capacity to influence nursing wage rates. Also important is the administrative staff's ability to organize service delivery in the nursing department, i.e., to influence skill mix and labor productivity. The nursing cost results strongly imply that a major pathway for the Program's influence on cost is labor usage -- a premise addressed in later analyses.

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[9] The high correlations among total and departmental costs suggest, but do not guarantee, this result. Exemplifying this point is that the strengths of the Program's effects on the departmental costs are distinctly different. The study by O'Donoghue, Gatch, and Hoffman (1977) also supports this point. It showed that despite high correlations among total and departmental costs, the latter are influenced to varying degrees by different determinants in accord with substantive expectations.

It has been argued at times that since prospective rate setting programs are usually directed toward the administrative staff, they should more strongly impact administrative/hotel cost than nursing and ancillary costs. The rationale is that the administrative staff generally exerts more control over administrative and hotel units than over ancillary and nursing units. Yet in these analyses the Program's impact on administrative/hotel cost is weaker than its effects on not only nursing cost but also ancillary cost.

This result does not cast doubt on the administrative staff's greater managerial freedom in the administrative/hotel department than in the other two departments. However, this characteristic is not strong enough to override two other characteristics of this department -- its lower labor dominance and the hospital's lesser ability to affect wage rates in the department. Many administrative/hotel employees are unspecialized personnel; and labor dominance is especially low in units such as dietary, pharmacy, and plant operation.

The ancillary cost findings do not necessarily imply that the administrative staff exerts a major influence on ancillary service intensity or that the Program induces the physician staff to reduce such intensity. Instead, it is much more likely that the Program impacts ancillary cost because the hospital's ability to affect ancillary wage rates is high. Most ancillary personnel are specialized to the health care field and some are specialized only to hospitals. Facilitating this ability is the moderately high labor dominance of the ancillary department.

The Program's effects on the departmental costs are similar in the Michigan and Tristate analyses, which substantiates the conclusion drawn from the total cost analyses that the Michigan Type II environment has been neither more nor less effective in restraining costs than has the Tristate Type I environment.

Detailed Findings

As displayed in Table 12-14, the predictive power of the nursing cost annual analyses is substantial, although not as high as that of the total cost annual analyses. The R^2s range from .75 in the 1973 Michigan equation to .54 in the 1970 Tristate comparison. In the Combined analyses they approximate .67.

Collinearity involving the Indiana Program is low. The Program's covariance ratio ranges from .00 to .13 and is never higher than .05 in the Combined equations. Overall collinearity is moderate, with the determinant ranging from .99 to .56.

The Program's impact on nursing cost is significant at the .001 level in all the Combined equations. The same is true in the Michigan analyses with the exception of the 1968 equation, in which the Program's influence is significant at the .01 level. In the Tristate analyses the Program's effect is significant at the .001 level in the two later study years and at the .01 level in the other years.

Table 12-14

ANNUAL ANALYSES OF NURSING COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-30×10^{0}	-30×10^{0}	-22×10^{0}	-96×10^{-1}	-33×10^{0}	-38×10^{0}	-28×10^{0}	-87×10^{-1}	-23×10^{0}	-18×10^{0}	-12×10^{0}	-92×10^{-1}
t-value	-5.88	-5.50	-5.05	-3.20	-5.16	-5.66	-5.40	-2.35	-4.70	-3.80	-2.71	-3.01
% impact	-15.2	-16.2	-13.7	-8.1	-15.8	-18.9	-16.5	-6.9	-12.8	-10.8	-8.2	-7.6
covariance	0.04	0.04	0.05	0.05	0.11	0.07	0.13	0.13	0.07	0.01	0.00	0.03
Length of Stay												
coefficient	28×10^{0}	27×10^{0}	22×10^{0}	15×10^{0}	28×10^{0}	27×10^{0}	21×10^{0}	15×10^{0}	24×10^{0}	22×10^{0}	21×10^{0}	15×10^{0}
t-value	14.20	12.90	14.36	15.45	11.69	10.55	10.30	12.25	11.09	11.41	12.79	13.90
Medical Education												
coefficient	75×10^{1}	87×10^{1}	48×10^{1}	42×10^{1}	71×10^{1}	84×10^{1}	45×10^{1}	43×10^{1}	56×10^{1}	38×10^{1}		31×10^{1}
t-value	8.74	8.74	5.51	6.86	7.50	7.76	4.74	6.25	3.43	2.35		3.31
Fiscal Year												
coefficient	19×10^{-1}		18×10^{-1}	11×10^{-1}	24×10^{-1}		21×10^{-1}	12×10^{-1}				
t-value	2.41		2.70	2.31	2.25		2.40	2.00				
Nonprofit Control												
coefficient	-23×10^{0}	-20×10^{0}	-15×10^{0}	-85×10^{-1}	-28×10^{0}	-24×10^{0}	-15×10^{0}	-72×10^{-1}	-92×10^{-1}			-68×10^{-1}
t-value	-4.31	-3.55	-3.36	-2.79	-4.26	-3.47	-2.78	-1.92	-1.66			-2.04
Income												
coefficient	79×10^{-4}	73×10^{-4}	82×10^{-4}	70×10^{-4}	91×10^{-4}	86×10^{-4}	98×10^{-4}	80×10^{-4}	56×10^{-4}	46×10^{-4}	46×10^{-4}	57×10^{-4}
t-value	4.28	3.46	5.17	6.33	3.74	3.13	4.96	5.66	2.66	2.30	2.56	4.29
R^2	0.70	0.67	0.64	0.67	0.75	0.72	0.68	0.71	0.57	0.58	0.54	0.64
Determinant	0.64	0.67	0.68	0.70	0.56	0.62	0.56	0.59	0.62	0.82	0.99	0.72
Constant	-92×10^{0}	-80×10^{0}	-99×10^{0}	-67×10^{0}	-10×10^{1}	-85×10^{0}	-10×10^{1}	-83×10^{0}	-46×10^{0}	-41×10^{0}	-56×10^{0}	-48×10^{0}

Length of stay, income level, and medical education involvement have strong positive effects on nursing cost as they do on total cost. Another total cost determinant, fiscal year, has a positive effect on nursing cost, but only in the Combined and Michigan equations. Nonprofit control, which is not a total cost determinant, has a consistent negative influence on nursing cost.

The predictive power of the nursing cost percentage change analyses is sizeable, although again not as high as that of the total cost percentage change analyses. As shown in Table 12-15, the R^2s range from .44 to .36, equalling .41 in the Combined equation. Collinearity involving the Indiana Program is low, with the Program's covariance ratio never exceeding .09. Overall collinearity is low in the Tristate equation and moderate in the other two equations.

Table 12-15

PERCENTAGE CHANGE ANALYSES OF NURSING COST

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-11×10^{-2}	-16×10^{-2}	-52×10^{-3}
t-value	-3.22	-3.62	-1.41
% impact	-19.2	-23.0	-10.0
covariance	0.05	0.09	0.07
% Δ Length of Stay			
coefficient	15×10^{-1}	13×10^{-1}	15×10^{-1}
t-value	10.36	8.19	9.50
% Δ Elderly Caseload			
coefficient	16×10^{-2}	34×10^{-2}	
t-value	1.76	2.30	
Nonprofit Control			
coefficient	-70×10^{-3}	-10×10^{-2}	
t-value	-1.93	-2.33	
Income			
coefficient	-31×10^{-6}	-42×10^{-6}	
t-value	-2.24	-2.34	
White Population			
coefficient	-73×10^{-2}	-79×10^{-2}	
t-value	-2.41	-2.33	
R^2	0.41	0.44	0.36
Determinant	0.53	0.50	0.93
Constant	17×10^{-1}	19×10^{-1}	62×10^{-2}

In the Combined and Michigan equations the Program's impact is significant at the .001 level. As indicated earlier, in the Tristate equation its effect is negative but only significant at the .10 level. In that equation the percentage impact statistic is -10%.

The percentage change in length of stay has a strong positive impact on the percentage change in nursing cost. While it is the only determinant in the Tristate equation, the Combined and Michigan equations have four other determinants: income level, white population, nonprofit control, and the percentage change in elderly caseload. The impact of the first three variables is negative, and that of the latter is positive.

The predictive power of the administrative/hotel cost annual analyses is similar to that of the nursing cost annual analyses. As displayed in Table 12-16, the R^2s range from .75 to .57. They approximate .68 in the Combined equations. Collinearty involving the Indiana Program is modest, with the Program's covariance ratio ranging from .06 to .21. Overall collinearity is substantial but is not high enough to present an analytical problem. The determinant ranges from .70 to .12.

In the Combined analyses the Program's impact on administrative/hotel cost is significant at the .01 level in 1973 and 1972. It is clearly insignificant in the early study years. In the Michigan comparisons the Program's effect is significant at the .001 level in 1972 and at the .01 level in 1973. In partial contrast to the Combined findings, the Program's effect is significant at the .10 level in 1970 and 1968. In the Tristate results the Program's 1973 impact is significant at the .01 level, and its 1972 influence is significant at the .05 level. Like the Combined findings, the Program's impact in the early study years is insignificant.

Similar to their total cost effects, five hospital characteristics -- length of stay, medical education involvement, ECF involvement, emergency/outpatient involvement, and fiscal year -- exert a positive influence on administrative/hotel cost. Two socioeconomic factors, income level and white population, have positive and negative effects respectively on this departmental cost, which resemble their influence on total cost. The remaining factor influencing administrative/hotel cost is not a total cost determinant. It is bed size, which has a negative impact most prominent in the Combined equations.

Table 12-16

ANNUAL ANALYSES OF ADMINISTRATIVE/HOTEL COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-24×10^{0}	-25×10^{0}	-47×10^{-1}	-37×10^{-1}	-31×10^{0}	-34×10^{0}	-13×10^{0}	-10×10^{0}	-26×10^{0}	-18×10^{0}	11×10^{-1}	-34×10^{-1}
t-value	-2.79	-2.95	-0.68	-0.69	-2.75	-3.46	-1.40	-1.47	-2.93	-1.78	0.16	-0.68
% impact	-7.1	-8.2	-1.9	-1.8	-8.6	-10.3	-4.8	-5.0	-8.3	-6.1	0.5	-1.8
covariance	0.09	0.08	0.09	0.08	0.21	0.21	0.21	0.13	0.13	0.06	0.08	0.08
Length of Stay												
coefficient	44×10^{0}	45×10^{0}	31×10^{0}	23×10^{0}	39×10^{0}	36×10^{0}	33×10^{0}	26×10^{0}	40×10^{0}	42×10^{0}	25×10^{0}	18×10^{0}
t-value	12.31	12.97	12.52	13.41	8.95	9.73	9.37	10.87	9.01	9.86	10.05	10.37
ECF Involvement												
coefficient	84×10^{0}	73×10^{0}	49×10^{0}	66×10^{0}	73×10^{0}	65×10^{0}	48×10^{0}	93×10^{0}	81×10^{0}	74×10^{0}	50×10^{0}	69×10^{0}
t-value	4.62	4.36	3.40	4.91	2.77	3.26	2.18	3.98	3.73	3.19	3.06	5.42
Emergency/Outpatient												
coefficient	35×10^{1}	20×10^{1}	26×10^{1}	26×10^{1}	45×10^{1}	22×10^{1}	38×10^{1}	24×10^{1}	19×10^{1}		20×10^{1}	29×10^{1}
t-value	4.20	2.13	3.26	3.43	4.00	1.80	2.99	2.23	1.81		2.32	3.46
Medical Education												
coefficient	10×10^{2}	85×10^{1}	75×10^{1}	85×10^{1}	79×10^{1}	63×10^{1}	49×10^{1}	78×10^{1}	18×10^{2}	14×10^{2}	77×10^{1}	62×10^{1}
t-value	6.65	4.85	4.76	6.70	4.88	4.06	2.97	6.01	5.31	3.90	3.25	3.99
Fiscal Year												
coefficient	49×10^{-1}	33×10^{-1}	45×10^{-1}	27×10^{-1}	57×10^{-1}	39×10^{-1}	52×10^{-1}		35×10^{-1}		29×10^{-1}	26×10^{-1}
t-value	3.71	2.50	4.19	3.28	3.23	2.57	3.57		2.25		2.36	2.96
Bed Size												
coefficient	-11×10^{-2}	-95×10^{-3}	-63×10^{-3}	-62×10^{-3}					-14×10^{-2}	-80×10^{-3}		
t-value	-3.29	-2.83	-2.26	-2.70					-3.35	-1.89		
Income												
coefficient	17×10^{-3}	16×10^{-3}	14×10^{-3}	12×10^{-3}	13×10^{-3}	13×10^{-3}	13×10^{-3}	12×10^{-3}	14×10^{-3}	17×10^{-3}	80×10^{-4}	10×10^{-3}
t-value	4.64	4.14	4.73	5.32	2.74	3.02	3.36	4.52	3.46	3.79	2.67	5.07
White												
coefficient	-35×10^{1}	-20×10^{1}	-23×10^{1}	-10×10^{1}	-39×10^{1}	-27×10^{1}	-18×10^{1}		-46×10^{1}		-21×10^{1}	
t-value	-4.40	-2.57	-3.90	-2.28	-4.22	-3.33	-2.62		-3.87		-2.68	
R^2	0.72	0.68	0.65	0.65	0.75	0.75	0.67	0.66	0.63	0.57	0.61	0.61
Determinant	0.18	0.18	0.20	0.22	0.26	0.25	0.29	0.64	0.12	0.32	0.46	0.70
Constant	11×10^{1}	-25×10^{0}	40×10^{0}	-40×10^{0}	20×10^{1}	12×10^{1}	-22×10^{0}	-14×10^{1}	31×10^{1}	-19×10^{1}	13×10^{1}	-91×10^{0}

The predictive power of the administrative/hotel cost percentage change analyses is higher than that of the nursing cost percentage change analyses but lower than that of the total cost percentage change analyses. The R^2s range from .50 to .42, as indicated in Table 12-17. Collinearity involving the Indiana Program is low, with the Program's covariance ratio never higher than .11. Overall collinearity is modest in the Combined and Michigan equations and substantial in the Tristate comparison.

Table 12-17

PERCENTAGE CHANGE ANALYSES OF
ADMINISTRATIVE/HOTEL COST

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-87×10^{-3}	-12×10^{-2}	-39×10^{-3}
t-value	-2.32	-2.54	-0.92
% impact	-12.0	-14.9	-5.9
covariance	0.03	0.06	0.11
% Δ Length of Stay			
coefficient	17×10^{-1}	17×10^{-1}	17×10^{-1}
t-value	11.30	9.79	8.83
% Δ ECF Involvement			
coefficient	78×10^{-4}	64×10^{-4}	77×10^{-4}
t-value	4.20	2.79	2.98
% Δ Emergency/Outpatient			
coefficient	11×10^{-2}	11×10^{-2}	
t-value	3.78	3.30	
ECF Involvement			
coefficient		-33×10^{-2}	
t-value		-2.06	
Elderly Caseload			
coefficient			63×10^{-2}
t-value			2.48
MD Concentration			
coefficient			19×10^{-4}
t-value			2.01
White Population			
coefficient	-87×10^{-2}	-84×10^{-2}	-12×10^{-1}
t-value	-3.03	-2.60	-2.29
R^2	0.44	0.50	0.42
Determinant	0.83	0.80	0.37
Constant	16×10^{-1}	16×10^{-1}	15×10^{-1}

In the Combined equation the Program's influence is almost significant at the .01 level. It is significant at that level in the Michigan comparison. In contrast, the Program's influence in the Tristate equation is insignificant even at the .10 level. As discussed earlier, this result is inconsistent with the annual analyses.

As in the total cost percentage change analyses, the percentage changes in length of stay, ECF involvement, and emergency/outpatient involvement have positive effects on the percentage change in administrative/hotel cost. Similarly, white population has a negative effect, and physician concentration a positive impact, with the influence of the latter limited to the Tristate equation.

As shown in Table 12-18, the predictive power of the ancillary cost annual analyses is the lowest among the departmental cost annual analyses. However, it is still substantial. The R^2s range from .72 in the 1972 Michigan equation to .34 in the 1968 Tristate comparison. Collinearity involving the Indiana Program is modest, especially in the Combined analyses, where the Program's covariance ratio is never higher than .05. Overall collinearity is substantial, but not severe, with the determinant ranging from .57 to .35.

In the Combined analyses the Program's impact on ancillary cost is significant at the .001 level in the three later study years. In 1968 its effect is solidly significant at the .05 level. In the Michigan comparisons the Program's effect is significant at the .01 level in 1973 and 1970, and at the .05 level in 1972. In 1968 the Program's effect is only significant at the .10 level. In the Tristate findings the Program's effect is significant at the .001 level in 1973, and at the .05 level in 1972. In the early study years the Program's impact is only significant at the .10 level, although its effect is almost significant at the .05 level in 1968.

In general, the Program's impact on ancillary cost is stronger in the Combined equations than in the Michigan and Tristate comparisons. The difference is most striking for 1968, as shown in Table 12-12. In that year the Program has a -8% influence in the Combined comparison and an insignificant impact in the other two equations. However, this divergence is less pronounced than at first appears to be the case, since the Program's effects are significant at the .10 level in the 1968 Michigan and Tristate equations. Similarly, the Program's influence in the 1970 Tristate equation is significant at the .10 level, thereby reducing the apparent inconsistency of the 1970 results.

Length of stay and income level have strong positive effects on ancillary cost. The same is true for fiscal year, although its influence is not as marked as those of length of stay and income level. Physician concentration exerts a powerful positive influence on ancillary cost, which is stronger than its impact on total cost. Medical education involvement also has a positive impact, but unlike the other cost analyses, its effect on ancillary cost is confined to the later study years. The remaining determinant is bed size. Its impact on ancillary cost is positive, which stands in contrast to its negative influence on administrative/hotel cost, but explains its insignificant effect on total cost.

Table 12-18

ANNUAL ANALYSES OF ANCILLARY COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-23×10^{0}	-19×10^{0}	-15×10^{0}	-79×10^{-1}	-19×10^{0}	-13×10^{0}	-14×10^{0}	-70×10^{-1}	-19×10^{0}	-14×10^{0}	-78×10^{-1}	-67×10^{-1}
t-value	-3.69	-3.39	-3.15	-2.21	-2.52	-2.08	-2.42	-1.52	-2.62	-2.20	-1.45	-1.60
% impact	-12.1	-11.5	-11.7	-8.2	-9.9	-8.1	-10.5	-7.1	-10.9	-9.2	-6.6	-7.3
covariance	0.02	0.02	0.04	0.05	0.16	0.14	0.20	0.21	0.11	0.03	0.02	0.06
Length of Stay												
coefficient	17×10^{0}	16×10^{0}	87×10^{-1}	50×10^{-1}	19×10^{0}	16×10^{0}	10×10^{0}	63×10^{-1}	15×10^{0}	15×10^{0}	67×10^{-1}	36×10^{-1}
t-value	7.12	7.68	4.94	4.28	6,55	6.77	4.53	4.23	4.52	5.48	3.08	2.41
Emergency/Outpatient												
coefficient	28×10^{1}	21×10^{1}	18×10^{1}	12×10^{1}	43×10^{1}	48×10^{1}	36×10^{1}	11×10^{1}	14×10^{1}			12×10^{1}
t-value	4.65	3.51	3.17	2.47	5.62	5,69	4.63	1.68	1.67			1.79
Medical Education												
coefficient	76×10^{1}	76×10^{1}			67×10^{1}	65×10^{1}			95×10^{1}	10×10^{2}		
t-value	7.30	7.39			6.06	6,29			4,00	4.92		
Fiscal Year												
coefficient	25×10^{-1}	18×10^{-1}	21×10^{-1}	18×10^{-1}	39×10^{-1}	33×10^{-1}	37×10^{-1}	31×10^{-1}				16×10^{-1}
t-value	2.62	2.08	2.76	3.30	3,20	3.13	4.05	4.23				2.10
Bed Size												
coefficient			62×10^{-3}	44×10^{-3}			66×10^{-3}	46×10^{-3}			63×10^{-3}	45×10^{-3}
t-value			3.47	3,12			3.19	2.61			2.99	2.52
MD Concentration												
coefficient	53×10^{-2}	39×10^{-2}	32×10^{-2}	28×10^{-2}	42×10^{-2}	29×10^{-2}	23×10^{-2}	28×10^{-2}	46×10^{-2}	33×10^{-2}	33×10^{-2}	22×10^{-2}
t-value	5.35	4.40	3.69	4.00	3.73	2.99	2.49	3.39	2,90	2,34	2.38	1.98
Income												
coefficient	72×10^{-4}	64×10^{-4}	86×10^{-4}	58×10^{-4}	97×10^{-4}	95×10^{-4}	10×10^{-3}	72×10^{-4}	71×10^{-4}	57×10^{-4}	59×10^{-4}	45×10^{-4}
t-value	3.10	3.01	4.45	4,02	3.27	3.62	4.37	3.73	2.39	2.14	2.39	2.34
R^2	0.64	0.63	0.49	0.45	0.71	0.72	0.61	0.53	0.46	0.50	0.39	0.34
Determinant	0.56	0.57	0.46	0.44	0.43	0.44	0.36	0.35	0.45	0.56	0.42	0.37
Constant	-10×10^{1}	-90×10^{0}	-85×10^{0}	-50×10^{0}	-16×10^{1}	-15×10^{1}	-13×10^{1}	-81×10^{0}	-55×10^{0}	-43×10^{0}	-24×10^{0}	-21×10^{0}

The predictive power of the ancillary cost percentage change analyses is distinctly lower than those of the other departmental cost percentage change analyses. This result occurs despite the presence of the same five determinants in each of these equations. As shown in Table 12-19, the R^2 ranges from .30 to .20, equalling .27 in the Combined equation. Collinearity involving the Indiana Program is modest; the Program's covariance ratio never exceeds .13. Overall collinearity is moderate, with the determinant approximating .55.

As discussed earlier, in the ancillary cost analyses the percentage change results are inconsistent with the annual findings. Thus, in the Combined and Michigan comparisons the Program's impact is not significant at the .05 level, although it is significant at the .10 level. In the Tristate equation it is not significant even at that level.

Table 12-19

PERCENTAGE CHANGE ANALYSES OF ANCILLARY COST

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-79×10^{-3}	-99×10^{-3}	-50×10^{-3}
t-value	-1.32	-1.37	-0.69
% impact	-8.0	-9.4	-5.5
covariance	0.02	0.08	0.13
% Δ Length of Stay			
coefficient	13×10^{-1}	11×10^{-1}	12×10^{-1}
t-value	5.19	3.88	3.56
% Δ Emergency/Outpatient			
coefficient	19×10^{-2}	20×10^{-2}	13×10^{-2}
t-value	3.88	3.49	2.06
Emergency/Outpatient			
coefficient	41×10^{-1}	45×10^{-1}	37×10^{-1}
t-value	4.54	3.81	2.94
Medical Education			
coefficient	55×10^{-1}	54×10^{-1}	84×10^{-1}
t-value	4.46	4.03	3.90
Elderly Caseload			
coefficient	11×10^{-1}	10×10^{-1}	95×10^{-2}
t-value	3.30	2.49	2.49
R^2	0.27	0.30	0.20
Determinant	0.57	0.54	0.50
Constant	21×10^{-2}	20×10^{-2}	27×10^{-2}

The percentage change in length of stay exerts a positive impact on the percentage change in ancillary cost, but its influence is not as great in these analyses as in the other cost analyses. The percentage change in emergency/outpatient involvement also exerts a positive influence in these analyses as does emergency/outpatient involvement itself. Medical education involvement and elderly caseload are the remaining determinants of this ancillary cost variable. Both have a positive impact.

13.
Effects on Productivity and Resource Usage

The Chapter 12 analyses show that the Indiana Program has a strong negative influence on hospital costs. Given this finding, it is essential to identify the mechanisms through which the Program achieves this effect. This chapter initiates this process. Using the same format as the previous chapter, it examines sequentially the Indiana system's impact on productivity; its influence on resource usage; and the effects of productivity and resource usage on cost.

Productivity

Overall Results

Findings -- It was hypothesized in Chapter 10 that the Indiana Program would have a positive influence on labor productivity in 1973, and a modestly positive or insignificant effect on this variable in 1968. It was also expected that the Program would have a positive impact on the percentage change in labor productivity.

As shown in Table 13-1, the findings substantiate these hypotheses. In the Combined analyses the Program's 1973 impact is +7%. In this year its impact raises labor productivity by 1.2 admissions per FTE. In contrast, the Program's influence in 1968 is insignificant. The results in the middle two study years are supportive of these findings. The Program's influence is +4% in 1970 and +8% in 1972.

Table 13-1

IMPACT OF INDIANA PROGRAM ON LABOR PRODUCTIVITY

	COMBINED	MICHIGAN	TRISTATE
1973	+7%	+8%	+8%
1972	+8%	+12%	+6%
1970	+4%	+8%	0
1968	0	0	0
% Δ '68-'73	+47%	+43%	+55%

In accord with the annual analyses, the Program's impact on the percentage change in labor productivity is positive, +47%. However, the average percentage change in labor productivity during the study years was only modest. The Program's influence in absolute terms is therefore less striking, although still substantial, +5.1%. That is, as an approximation, if the control hospitals had been operating under the Indiana Program, the average decline in their labor productivity would have been -5.8% rather than -10.9% -- a relative difference of +47%.

The Michigan and Tristate results are also fully supportive of the Chapter 10 hypotheses. In both analyses the Program's impact is +8% in 1973; in both it is insignificant in 1968. In the middle study years the Program's influence is stronger in the Michigan analyses than in the Tristate comparisons: +12% versus +6% in 1972, and +8% versus insignificance in 1970. In the percentage change analyses the Program's effects are similar: +43% in the Michigan comparison and +55% in the Tristate analysis.

It was expected that the Indiana Program would have a positive influence on capital productivity in 1973, and a modestly positive or insignificant effect on this variable in 1968. Accordingly, it was hypothesized that the Program's impact on the percentage change in this variable would be positive.

These hypotheses receive only limited support from the findings. As displayed in Table 13-2, in the Combined analyses the Program has a +4% impact on capital productivity in 1968 and 1972. However, in the other two years its influence is insignificant. So is its impact on the percentage change in capital productivity. In the Michigan analyses the Program's influence is insignificant in all time periods except 1970, when its impact is +4%.

Table 13-2

IMPACT OF INDIANA PROGRAM ON CAPITAL PRODUCTIVITY

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	+5%
1972	+4%	0	+5%
1970	0	+4%	0
1968	+4%	0	0
% Δ '68-'73	0	0	0

Conformance to the Chapter 10 hypotheses is strongest in the Tristate analyses where the Program exerts a +5% influence in both 1973 and 1972. Its impact in the two early study years is insignificant. The Program's effect on the percentage change in capital productivity is also insignificant. Since the annual and percentage change findings are thus inconsistent, emphasis is placed on the annual results for the reasons discussed earlier. However, in this instance the inconsistency is softened by the finding that the Program's influence on the percentage change in capital productivity is significant at the .10 level, albeit not at the .05 level.

Interpretation -- The Program has a major impact on labor productivity. As with total cost, this influence is stronger in the later study years. In fact, it is insignificant in 1968. Consistent with these results, the Program has a substantial positive effect on the percentage change in labor productivity. These analyses thus establish that the Program has been successful in impacting hospital utilization of labor resources -- by necessity a central objective of prospective rate setting.

Unlike its labor productivity effect, the Program's impact on capital productivity is weaker than expected. In the Combined analyses the Program does have a positive impact on capital productivity in 1968 and 1972. However, the Program's influence on capital productivity is insignificant in the other two years as is its impact on the percentage change in this variable. The Program thus does not have a strong, accelerating impact on capital productivity similar to its effect on labor productivity.

This finding has two implications. First, because of the hospital's labor dominance, capital productivity is expected to have a much less powerful influence than labor productivity on cost. Hence, to influence cost through capital productivity a prospective rate setting program must have a particularly strong impact on the latter variable. Given the results of these analyses, it is unlikely that the Indiana Program appreciably affects cost by influencing capital productivity -- a conclusion definitively tested in later Segment I analyses.

Second, the capital productivity results imply that the Program is less effective in influencing capital usage than would be expected on the basis of Program characteristics. Capital usage and specifically capital productivity have been major emphases of the Indiana Program since its inception. Yet these analyses demonstrate only an inconsistent effect on capital productivity distinctly weaker than the Program's influence on labor productivity. There is thus a clear divergence between the Program's effects on the two productivity measures and the similar attention that the Program devotes to them.

Detailed Findings

The predictive power of the labor productivity annual analyses is substantial, as seen in Table 13-3. The R^2s range from .69 in the 1973 Michigan equation to .44 in the 1968 Tristate comparison. Collinearity

Table 13-3

ANNUAL ANALYSES OF LABOR PRODUCTIVITY

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	12×10^{-1}	13×10^{-1}	81×10^{-2}	29×10^{-2}	13×10^{-1}	19×10^{-1}	13×10^{-1}	45×10^{-2}	13×10^{-1}	11×10^{-1}	67×10^{-2}	19×10^{-2}
t-value	2.99	2.89	1.77	0.54	2.52	3.39	2.58	0.76	3.08	2.27	1.25	0.32
% impact	6.9	7.6	4.4	1.5	7.7	11.7	7.5	2.4	7.6	6.1	3.5	1.0
covariance	0.05	0.05	0.05	0.05	0.15	0.13	0.12	0.10	0.05	0.02	0.03	0.06
Length of Stay												
coefficient	-18×10^{-1}	-21×10^{-1}	-15×10^{-1}	-15×10^{-1}	-19×10^{-1}	-17×10^{-1}	-16×10^{-1}	-16×10^{-1}	-22×10^{-1}	-21×10^{-1}	-15×10^{-1}	-15×10^{-1}
t-value	-11.90	-12.91	-9.24	-8.80	-10.97	-7.86	-8.05	-8.09	-11.61	-10.60	-7.43	-7.65
ECF Involvement												
coefficient	-42×10^{-1}	-34×10^{-1}	-40×10^{-1}	-46×10^{-1}	-53×10^{-1}	-55×10^{-1}	-58×10^{-1}	-84×10^{-1}	-31×10^{-1}		-22×10^{-1}	-35×10^{-1}
t-value	-5.11	-3.45	-3.91	-3.40	-4.29	-3.53	-4.06	-4.50	-3.02		-1.71	-2.22
Medical Education												
coefficient	-11×10^{0}	-21×10^{0}	-24×10^{0}	-22×10^{0}	-14×10^{0}	-13×10^{0}	-19×10^{0}	-18×10^{0}	-51×10^{0}	-39×10^{0}	-44×10^{0}	
t-value	-1.81	-2.93	-2.87	-2.18	-2.22	-1.65	-2.24	-1.78	-3.72	-2.74	-2.21	
White Population												
coefficient	77×10^{-1}		12×10^{0}	11×10^{0}		77×10^{-1}	94×10^{-1}	98×10^{-1}			18×10^{0}	19×10^{0}
t-value	2.42		3.36	2.76		1.91	2.65	2.46			3.18	3.28
Education												
coefficient	-17×10^{-1}	-12×10^{-1}	-98×10^{-2}	-14×10^{-1}	-27×10^{-1}	-23×10^{-1}	-17×10^{-1}	-24×10^{-1}	-13×10^{-1}	-93×10^{-2}		-11×10^{-1}
t-value	-5.00	-3.12	-2.54	-3.17	-6.09	-4.54	-3.68	-4.34	-3.55	-2.26		-2.19
R^2	0.64	0.62	0.53	0.46	0.69	0.67	0.63	0.57	0.65	0.62	0.47	0.44
Determinant	0.56	0.82	0.70	0.72	0.68	0.46	0.56	0.60	0.82	0.80	0.78	0.86
Constant	44×10^{0}	48×10^{0}	31×10^{0}	38×10^{0}	64×10^{0}	50×10^{0}	42×10^{0}	51×10^{0}	49×10^{0}	45×10^{0}	14×10^{0}	27×10^{0}

involving the Indiana Program is low. The Program's covariance ratio never exceeds .15; it equals .05 in all the Combined equations. Overall collinearity is moderate. The determinant ranges from .86 to .46.

In the Combined analyses, the Program's influence is significant at the .01 level in the two later study years. It is significant at the .05 level in 1970 but is clearly insignificant in 1968. In the Michigan comparisons the Program's effect is significant at the .001 level in 1972 and at the .01 level in 1973 and 1970. It is insignificant in 1968. In the Tristate analyses the Program's influence is almost significant at the .001 level in 1973; it is significant at the .05 level in 1972. In the early study years the Program's impact is insignificant, although it approaches significance at the .10 level in 1970.

The strongest determinant of labor productivity is length of stay, which has a negative influence. Three other variables exert a negative effect: ECF involvement, medical education involvement, and education level. The remaining determinant is white population, which has a positive influence most marked in the early years.

The predictive power of the labor productivity percentage change analyses is solid but distinctly lower than that of the annual analyses. As indicated in Table 13-4, the R^2s approximate .30 in these equations. Collinearity involving the Indiana Program is low, with the Program's covariance ratio never higher than .06. Overall collinearity is also low; the determinant is never below .90.

Table 13-4

PERCENTAGE CHANGE ANALYSES OF LABOR PRODUCTIVITY

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	51×10^{-3}	55×10^{-3}	58×10^{-3}
t-value	2.38	2.13	2.33
% impact	46.5	43.4	54.9
covariance	0.01	0.02	0.06
% Δ Length of Stay			
coefficient	-70×10^{-2}	-66×10^{-2}	-74×10^{-2}
t-value	-8.49	-6.55	-7.12
% Δ ECF Involvement			
coefficient	-36×10^{-4}	-30×10^{-4}	-34×10^{-4}
t-value	-3.17	-2.15	-2.29
ECF Involvement			
coefficient		25×10^{-2}	
t-value		2.96	
R^2	0.29	0.33	0.29
Determinant	0.95	0.90	0.94
Constant	-14×10^{-2}	-14×10^{-2}	-14×10^{-2}

In the Combined equation the Program's effect is significant at the .01 level and is almost significant at that level in the Tristate comparison. It is solidly significant at the .05 level in the Michigan equation.

Analogous to the annual analyses, the percentage changes in length of stay and ECF involvement have strong negative effects on the percentage change in labor productivity. The only other determinant is ECF involvement, which has a positive impact in the Michigan equation.

The predictive power of the capital productivity annual analyses is sizeable, although somewhat lower than that of the labor productivity annual analyses. As displayed in Table 13-5, the R^2s range narrowly from .58 to .49. Collinearity involving the Indiana Program is low. The Program's covariance ratio ranges from .00 to .07, never exceeding .03 in the Combined equations. Overall collinearity is modest since the determinant is never lower than .46.

In none of these equations is the Program's influence significant at the .01 level. In the Combined analyses it is significant at the .05 level in 1972 and 1968. It is solidly significant at the .10 level in the other two years. In the Michigan analyses the Program's effect is significant at the .05 level in 1970 and at the .10 level in 1972 and 1968, but it is thoroughly insignificant in 1973. In the Tristate results the Program's effect is significant at the .05 level in 1973 and 1972. In 1968 it is significant at the .10 level, but in 1970 it is clearly insignificant.

Length of stay has the strongest impact on capital productivity, as it does on labor productivity. Again, its influence is negative. Elderly caseload also exerts a strong negative influence on capital productivity. Among the socioeconomic variables, education level has a negative impact in the later study years, while income level has a negative effect in 1968. Physician concentration has a positive impact which is largely confined to the later study years.

Table 13-5

ANNUAL ANALYSES OF CAPITAL PRODUCTIVITY

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	10×10^{-1}	14×10^{-1}	98×10^{-2}	13×10^{-1}	48×10^{-2}	12×10^{-1}	16×10^{-1}	11×10^{-1}	18×10^{-1}	18×10^{-1}	26×10^{-2}	12×10^{-1}
t-value	1.52	2.01	1.46	1.85	0.60	1.43	1.90	1.34	2.22	2.21	0.34	1.48
% impact	2.9	3.9	2.7	3.5	1.3	3.3	4.3	3.0	5.0	5.0	0.7	3.2
covariance	0.01	0.00	0.01	0.03	0.06	0.03	0.06	0.07	0.07	0.05	0.01	0.04
Length of Stay												
coefficient	-34×10^{-1}	-35×10^{-1}	-32×10^{-1}	-31×10^{-1}	-34×10^{-1}	-32×10^{-1}	-33×10^{-1}	-34×10^{-1}	-40×10^{-1}	-38×10^{-1}	-30×10^{-1}	-30×10^{-1}
t-value	-13.31	-13.64	-12.92	-13.66	-11.55	-10.82	-10.66	-12.72	-10.98	-11.45	-10.53	-10.95
Elderly Caseload												
coefficient	-27×10^{0}	-27×10^{0}	-21×10^{0}	-24×10^{0}	-24×10^{0}	-26×10^{0}	-22×10^{0}	-21×10^{0}	-28×10^{0}	-28×10^{0}	-24×10^{0}	-25×10^{0}
t-value	-7.29	-7.14	-6.18	-5.49	-5.56	-5.72	-5.20	-3.67	-6.30	-5.94	-5.92	-4.97
MD Concentration												
coefficient	27×10^{-3}	26×10^{-3}	24×10^{-3}		25×10^{-3}				42×10^{-3}	36×10^{-3}		
t-value	2.25	2.33	1.96		1.95				2.39	2.09		
Income												
coefficient				-10×10^{-4}				-71×10^{-5}				-15×10^{-4}
t-value				-3.14				-1.77				-3.53
Education												
coefficient	-27×10^{-1}	-23×10^{-1}	-17×10^{-1}		-29×10^{-1}	-20×10^{-1}			-27×10^{-1}	-20×10^{-1}	-15×10^{-1}	
t-value	-4.07	-3.60	-2.75		-3.45	-2.45			-3.67	-2.71	-2.12	
R^2	0.49	0.52	0.52	0.54	0.53	0.50	0.49	0.58	0.52	0.55	0.53	0.54
Determinant	0.63	0.67	0.70	0.52	0.57	0.86	0.94	0.46	0.56	0.62	0.90	0.55
Constant	10×10^{1}	98×10^{0}	88×10^{0}	80×10^{0}	10×10^{1}	93×10^{0}	70×10^{0}	79×10^{0}	11×10^{1}	94×10^{0}	87×10^{0}	85×10^{0}

The predictive power of the capital productivity percentage change analyses is sizeable. It is moderately higher than that of the labor productivity percentage change analyses. The R^2s range from .47 in the Michigan equation to .27 in the Tristate comparison, as shown in Table 13-6. As in the other productivity analyses, collinearity involving the Indiana Program is low. The Program's covariance ratio never exceeds .12. The determinant ranges from .63 to .49, indicating that overall collinearity is moderate.

Table 13-6

PERCENTAGE CHANGE ANALYSES OF CAPITAL PRODUCTIVITY

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-67×10^{-4}	-63×10^{-5}	-36×10^{-4}
t-value	-0.31	-0.03	-0.14
% impact	-213.1	-3.5	-87.6
covariance	0.04	0.12	0.08
% Δ Length of Stay			
coefficient	-73×10^{-2}	-66×10^{-2}	-75×10^{-2}
t-value	-8.84	-7.62	-6.56
% Δ Bed Size			
coefficient	-12×10^{-2}	-25×10^{-2}	-12×10^{-2}
t-value	-3.17	-5.17	-2.63
% Δ Elderly Caseload			
coefficient	-13×10^{-2}	-22×10^{-2}	
t-value	-2.38	-2.79	
% Δ MD Concentration			
coefficient	13×10^{-2}	20×10^{-2}	
t-value	2.09	2.97	
Income			
coefficient	32×10^{-6}	31×10^{-6}	46×10^{-6}
t-value	3.63	3.19	3.77
Education			
coefficient	-62×10^{-3}	-11×10^{-2}	-71×10^{-3}
t-value	-2.79	-4.26	-2.60
R^2	0.34	0.47	0.27
Determinant	0.55	0.49	0.63
Constant	40×10^{-2}	95×10^{-2}	37×10^{-2}

In all these equations the Program's impact is thoroughly insignificant. The highest t-value is -.31 in the Combined equation.

The percentage change in length of stay has a strong negative influence on the percentage change in capital productivity. Also analogous to the annual analyses, the percentage changes in elderly caseload and physician concentration have negative and positive effects respectively. One other percentage change variable is a determinant in these analyses: the percentage change in bed size, which exerts a negative influence. The remaining determinants are income level and education level, which have positive and negative effects respectively, in consonance with the annual analyses.

Resource Usage

Overall Results

Findings -- It was hypothesized that the Indiana Program would have a strong negative impact on average salary in 1973; a negative influence on this variable in 1968; and a negative effect on the percentage change in average salary.

The results partially support these hypotheses. As indicated in Table 13-7, in the Combined analyses the Program's impact on average salary is -8% in 1973, but its influence is also -8% in 1968. It has similar effects in the two middle years: -9% in 1972 and -6% in 1970. The Program's effect on the percentage change in average salary is insignificant. However, since average salary increases substantially during the study years and since the Program's percentage impact on this variable remains almost constant, its dollar impact on average salary steadily rises, increasing from -$39 in 1968 to -$58 in 1973.

Table 13-7

IMPACT OF INDIANA PROGRAM ON AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
1973	-8%	-12%	-4%
1972	-9%	-13%	-7%
1970	-6%	-10%	-4%
1968	-8%	-9%	-7%
% Δ '68-'73	0	-16%	0

The Tristate findings resemble the Combined results, but the Program's influence on average salary is less consistent. It equals -7% in 1968 and 1972, and -4% in 1970 and 1973. The Program's influence on the percentage change in average salary is insignificant.

The Michigan findings conform to the Chapter 10 hypotheses more closely. The Program's impact in 1973 is -12%, which is higher than its effect in 1968, -9%. Consistent with these results, its influence is -13% in 1972 and -10% in 1970. Further, the Program's impact on the percentage change in average salary is negative, -16%.

It was expected that in the Tristate and Combined analyses the Indiana Program would have an insignificant effect on capital intensity in both 1973 and 1968, as well as an insignificant influence on the percentage change in this variable. However, it was hypothesized that due to the impact of the Michigan program, capital intensity would be higher in Michigan hospitals than in Indiana hospitals. It was further anticipated that this capital intensity effect would be present in the 1973 and percentage change results, but not in the 1968 findings.

The Tristate and Combined findings corroborate these hypotheses, while the Michigan results are partially supportive. As displayed in Table 13-8, in the Tristate analyses the Program's influence is insignificant in all four study years as is its effect on the percentage change in capital intensity. The same findings characterize the Combined analyses.

Table 13-8

IMPACT OF INDIANA PROGRAM ON CAPITAL INTENSITY

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1972	0	0	0
1970	0	0	0
1968	0	+17%	0
% Δ '68-'73	0	-50%	0

In the Michigan analyses Indiana hospitals exhibit a lower percentage change in capital intensity than do Michigan hospitals, as postulated in Chapter 10. The effect on this percentage change variable is

-50%. However, in 1973 there is no significant difference in capital intensity between Indiana and Michigan hospitals. The same finding holds in 1972 and 1970. However, in 1968 capital intensity is higher in Indiana hospitals than in Michigan hospitals, with the magnitude of this effect being +17%.

It was expected that the Indiana Program would have a negative impact on payroll/cost in both 1973 and 1968. It was further hypothesized that the Program's influence on the percentage change in this variable would be insignificant.

The findings largely support these hypotheses. As displayed in Table 13-9, in the Combined analyses the Program has a negative influence in all four years. Its effect is highest in 1968 and 1970, equalling -4%. Its impact then declines to -3% in 1972 and to -2% in 1973. However, the Program's influence on the percentage change in this variable is insignificant. Conflict thus exists between the annual and percentage change analyses, since the Program's declining influence in the former is not reflected in the latter. In accord with the rationale discussed earlier, the annual findings are therefore given precedence.

Table 13-9

IMPACT OF INDIANA PROGRAM ON PAYROLL/COST

	COMBINED	MICHIGAN	TRISTATE
1973	-2%	-4%	0
1972	-3%	-4%	-3%
1970	-4%	-8%	0
1968	-4%	-5%	-3%
% Δ '68-'73	0	0	0

The Michigan results resemble the Combined findings, but in each time period the Program's impact is stronger in the Michigan analyses. In those analyses the Program exerts a -5% influence in 1968 and a -4% impact in 1973, with its effects in the two intervening years equalling -8% and -4%. Its impact on the percentage change in payroll/cost is insignificant. In contrast, in the Tristate analyses the Program's influence is significant only in 1968 and 1972, equalling -3% in both years.

Interpretation -- The importance of average salary arises from the same source as that of labor productivity -- the dominance of labor in the hospital. Together these two variables determine labor cost. That is, labor cost (defined as payroll per case) equals the product of average salary (payroll per FTE) and the inverse of labor productivity (FTE per case). These analyses show that the Indiana system impacts average salary. Since earlier analyses demonstrate that it influences labor productivity, its effects on labor usage are pervasive.

The Program's effects on these two variables exhibit distinctly different patterns. While its dollar impact on average salary rises during the study years, its percentage influence remains stable, equalling -8% in both 1973 and 1968. In contrast, the Indiana system's impact on labor productivity accelerates during the study years, rising from insignificance in 1968 to +7% in 1973.

The capital intensity results virtually eliminate an important mechanism through which the Indiana Program could influence cost. As expected, in the Combined and Tristate analyses the Program's impact on this variable is insignificant in all study time periods. Michigan hospitals do display a higher percentage increase in capital intensity during the study years than do Indiana hospitals. This effect may contribute to the differences between Indiana and Michigan hospitals in terms of the percentage change in cost. However, in the last three study years there are no significant differences between Indiana and Michigan hospitals in terms of capital intensity. Moreover, in 1968 capital intensity is higher in Indiana hospitals -- an effect which offsets rather than enhances a negative cost impact.

The Michigan findings do not specifically conform to the Chapter 10 hypotheses, but they are consistent with the thesis underlying those hypotheses. That is, they suggest that the Michigan program increases capital intensity by shifting capital expenditures from bed construction to other projects. It is uncertain whether the Indiana system or the Michigan program is responsible for the greater capital intensity of Indiana hospitals in 1968. However, given that the Indiana Program has an insignificant influence on capital intensity in the Tristate analyses, it is likely that the Michigan program is responsible for the smaller percentage increase in capital intensity in Indiana hospitals during the study years.[1] This thesis will be further examined in Segment II by analyzing capital expenditures and the percentage change in bed size.

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[1] The Michigan program also increases personnel/bed (FTEs divided by beds). The rationale for this effect is similar to that for the increase in capital intensity. As hospitals find it more difficult to increase or modernize bed capacity, one method of achieving their goals is to intensify their use of labor inputs.

Two important findings emerge from the payroll/cost analyses. First, the Program has a consistent negative impact on this variable, confirming the key premise that the Program's effect on labor costs would be greater than its influence on nonlabor costs. Specifically, this finding is supportive of the departmental cost results, and the average salary and labor productivity findings.

Second, the Program's influence on payroll/cost steadily declines during the study period. Given its accelerating influence on total cost and its effects on labor productivity and average salary, this finding means that the Program's impact on nonlabor costs increased substantially during the study years. Segment II builds upon this result by analyzing the Program's effects on two types of nonlabor costs -- supply/service cost and capital cost.

Detailed Findings

The predictive power of the average salary annual analyses is substantial. It is distinctly lower in the Tristate equations than in the Combined and Michigan analyses. As displayed in Table 13-10, the R^2s approximate .43 in the Combined equations, .52 in the Michigan comparisons, and .23 in the Tristate analyses. Collinearity involving the Indiana Program is low, with the Program's covariance ratio never exceeding .11. In the Combined equations the covariance ratio approximates .04. Overall collinearity is modest, with the determinant never lower than .63.

In the Combined analyses the Program's impact is significant at the .001 level in all years except 1970, when its influence is significant at the .01 level. The effect of the Program is significant at the .001 level in all the Michigan equations, albeit narrowly so in 1968. In contrast, in the Tristate analyses the Program's influence is significant at the .01 level in 1968 and 1972, but it is only narrowly significant at the .05 level in 1973 and 1970.

Income level has a positive impact in all the analyses. Medical education involvement and physician concentration also have strong positive effects. The influence of the former is limited to the Combined and Michigan equations, while the impact of the latter is mainly restricted to the Combined and Tristate comparisons.

Table 13-10

ANNUAL ANALYSES OF AVERAGE SALARY

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-58×10^{1}	-64×10^{1}	-40×10^{1}	-39×10^{1}	-94×10^{1}	-95×10^{1}	-64×10^{1}	-45×10^{1}	-28×10^{1}	-43×10^{1}	-24×10^{1}	-37×10^{1}
t-value	-3.75	-3.96	-2.87	-3.53	-4.89	-4.54	-3.60	-3.15	-1.69	-2.48	-1.70	-2.90
% impact	-7.9	-9.2	-6.4	-7.5	-12.2	-13.0	-9.9	-8.5	-4.0	-6.5	-4.0	-7.1
covariance	0.03	0.04	0.04	0.04	0.08	0.11	0.11	0.09	0.04	0.03	0.03	0.03
Medical Education												
coefficient	15×10^{3}	12×10^{3}	15×10^{3}	10×10^{3}	13×10^{3}	91×10^{2}	13×10^{3}	95×10^{2}				
t-value	6.70	4.69	5.88	4.78	5.32	3.20	4.55	3.82				
MD Concentration												
coefficient	63×10^{-1}	47×10^{-1}	41×10^{-1}	46×10^{-1}	44×10^{-1}				11×10^{0}	79×10^{-1}	10×10^{0}	62×10^{-1}
t-value	2.89	2.09	1.87	2.34	1.74				3.39	2.35	3.45	2.24
Income												
coefficient	27×10^{-2}	25×10^{-2}	22×10^{-2}	17×10^{-2}	31×10^{-2}	38×10^{-2}	30×10^{-2}	24×10^{-2}	27×10^{-2}	20×10^{-2}	14×10^{-2}	17×10^{-2}
t-value	4.64	4.13	4.34	4.07	3.91	4.57	4.40	4.40	4.08	2.73	2.42	3.33
R^2	0.48	0.41	0.43	0.38	0.58	0.51	0.53	0.45	0.28	0.20	0.21	0.22
Determinant	0.76	0.75	0.73	0.74	0.63	0.70	0.69	0.72	0.86	0.89	0.86	0.87
Constant	41×10^{2}	41×10^{2}	36×10^{2}	32×10^{2}	42×10^{2}	35×10^{2}	34×10^{2}	28×10^{2}	36×10^{2}	42×10^{2}	39×10^{2}	31×10^{2}

The predictive power of the average salary percentage change analyses is low. Two factors contribute to this result. First, a percentage change measure was not available for income level. Second, the other two determinants in the annual analyses -- medical education involvement and physician concentration -- do not change appreciably during the study period. As displayed in Table 13-11, the R^2 ranges from .12 in the Michigan equation to .06 in the Tristate comparison. Reflecting the modest number of determinants, collinearity is low in these equations. The Program's covariance ratio never exceeds .02 and the determinant is never lower than .85.

Table 13-11

PERCENTAGE CHANGE ANALYSES OF AVERAGE SALARY

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-19×10^{-3}	-74×10^{-3}	37×10^{-3}
t-value	-0.62	-1.79	1.19
% impact	-4.7	-15.6	10.2
covariance	0.01	0.02	0.01
% Δ Emergency/Outpatient			
coefficient	89×10^{-3}	73×10^{-3}	61×10^{-3}
t-value	3.40	2.37	2.42
% Δ Elderly Caseload			
coefficient		34×10^{-2}	
t-value		2.19	
Emergency/Outpatient			
coefficient	15×10^{-1}		
t-value	2.61		
R^2	0.07	0.12	0.06
Determinant	0.85	0.97	0.99
Constant	26×10^{-2}	43×10^{-2}	33×10^{-2}

In the Michigan equation the Program's effect is significant at the .05 level; in the Combined analysis it is thoroughly insignificant. In the Tristate equation the Program's influence is positive but insignificant even at the .10 level.

The percentage change in emergency/outpatient involvement exerts a positive influence in all three equations. Emergency/outpatient involvement also has a positive effect in the Combined equation, while

the percentage change in elderly caseload has a positive influence in the Michigan comparison.

The predictive power of the capital intensity annual analyses is modest. As indicated in Table 13-12, the R^2s range from .25 to .10. Collinearity is low. The Program's covariance ratio never exceeds .11 and the determinant ranges from .93 to .58.

In the 1968 Michigan equation the Program's effect is significant at the .05 level. In the other Michigan analyses the Program's influence is negative but clearly insignificant. The Tristate results show that the Program's effect is negative in all four years. It is significant at the .10 level in 1973 and 1972, approaching significance at the .05 level in the former year. In the two early years its influence is insignificant. In the Combined analyses the Program's effect is negative in the later three study years; it is positive in 1968. However, in all the Combined equations the Program's influence is insignificant even at the .10 level.

Income level has a positive influence on capital intensity in all these equations, but its effect here is not as strong as its impact on average salary. ECF involvement and church control are also consistent positive determinants of capital intensity. In addition, physician concentration has a positive impact largely confined to the later study years, and emergency/outpatient involvement has a positive effect but only in the Michigan equations.

Table 13-12

ANNUAL ANALYSES OF CAPITAL INTENSITY

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-23×10^{2}	-22×10^{2}	-14×10^{2}	10×10^{2}	-82×10^{1}	-18×10^{2}	-14×10^{2}	26×10^{2}	-35×10^{2}	-29×10^{2}	-13×10^{2}	-16×10^{2}
t-value	-1.27	-1.26	-0.93	0.86	-0.43	-1.01	-0.77	2.07	-1.58	-1.35	-0.73	-1.14
% impact	-9.0	-9.2	-6.9	5.8	-3.4	-7.7	-6.6	17.1	-13.1	-11.6	-6.1	-8.2
covariance	0.05	0.05	0.06	0.05	0.11	0.09	0.06	0.01	0.07	0.06	0.08	0.00
ECF Involvement												
coefficient	12×10^{3}	90×10^{2}	69×10^{2}	65×10^{2}	12×10^{3}	78×10^{2}			12×10^{3}	13×10^{3}	97×10^{2}	
t-value	3.34	2.69	2.15	2.18	2.60	2.07			2.41	2.58	2.47	
Emergency/Outpatient												
coefficient					33×10^{3}		57×10^{3}					
t-value					1.69		2.13					
Church Control												
coefficient	50×10^{2}			38×10^{2}	56×10^{2}	49×10^{2}	50×10^{2}	35×10^{2}		48×10^{2}	47×10^{2}	38×10^{2}
t-value	2.10			2.74	2.15	2.00	2.08	2.10		1.72	2.15	2.15
MD Concentration												
coefficient	90×10^{0}	83×10^{0}	63×10^{0}		11×10^{1}	83×10^{0}			81×10^{0}			
t-value	3.12	2.89	2.32		3.52	2.80			1.93			
Income												
coefficient	16×10^{-1}	13×10^{-1}	15×10^{-1}	14×10^{-1}	19×10^{-1}	14×10^{-1}	15×10^{-1}	13×10^{-1}	19×10^{-1}	15×10^{-1}	17×10^{-1}	16×10^{-1}
t-value	2.30	1.95	2.58	3.45	2.46	1.87	2.36	2.72	2.04	1.67	2.47	2.73
R^2	0.16	0.10	0.10	0.11	0.25	0.18	0.13	0.12	0.13	0.11	0.13	0.11
Determinant	0.70	0.80	0.78	0.88	0.58	0.67	0.87	0.93	0.77	0.81	0.81	0.91
Constant	21×10^{2}	50×10^{2}	17×10^{2}	23×10^{2}	-73×10^{2}	29×10^{2}	79×10^{0}	19×10^{2}	16×10^{2}	86×10^{2}	25×10^{2}	33×10^{2}

The predictive power of the capital intensity percentage change analyses is low. As shown in Table 13-13, the R^2s range narrowly from .09 to .06. Collinearity is very low. It is highest in the Michigan equation, but even here the Program's covariance ratio is .06 and the determinant is .93.

Table 13-13

PERCENTAGE CHANGE ANALYSES OF CAPITAL INTENSITY

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-15×10^{-2}	-47×10^{-2}	57×10^{-3}
t-value	-0.83	-2.00	0.30
% impact	-22.0	-49.6	11.5
covariance	0.02	0.06	0.00
% Δ ECF Involvement			
coefficient	30×10^{-3}	20×10^{-3}	36×10^{-3}
t-value	3.39	1.78	3.11
% Δ Bed Size			
coefficient	65×10^{-2}	15×10^{-1}	
t-value	1.99	3.13	
R^2	0.06	0.09	0.06
Determinant	0.97	0.93	1.00
Constant	53×10^{-2}	70×10^{-2}	43×10^{-2}

The Program's effect is significant at the .05 level in the Michigan equation. It is clearly insignificant in the other comparisons. There are two other determinants in these analyses: the percentage changes in ECF involvement and bed size, both with positive effects.

The predictive power of the payroll/cost annual analyses is similar to that of the capital intensity annual analyses. It is thus modest, despite the presence of at least three determinants in each equation. As indicated in Table 13-14, the R^2s range from .26 to .11. Collinearity involving the Indiana Program is low; the Program's covariance ratio is never higher than .15, approximating .05 in the Combined equations. Overall collinearity is substantial, but not excessive. The determinant ranges from .86 to .22.

In the Combined analyses the Program's impact is significant at the .001 level in 1970, and at almost that level in 1968 and 1972. Its

Table 13-14

ANNUAL ANALYSES OF PAYROLL/COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Indiana Program												
coefficient	-14×10^{-3}	-20×10^{-3}	-28×10^{-3}	-23×10^{-3}	-22×10^{-3}	-27×10^{-3}	-49×10^{-3}	-30×10^{-3}	-42×10^{-4}	-16×10^{-3}	-12×10^{-3}	-20×10^{-3}
t-value	-2.13	-2.98	-4.03	-3.04	-2.98	-3.45	-5.56	-3.09	-0.60	-2.15	-1.60	-2.38
% impact	-2.3	-3.3	-4.4	-3.6	-3.8	-4.4	-7.6	-4.6	-0.7	-2.7	-2.0	-3.1
covariance	0.05	0.07	0.07	0.04	0.02	0.07	0.15	0.05	0.12	0.08	0.12	0.03
Bed Size												
coefficient		45×10^{-6}	67×10^{-6}	98×10^{-6}		72×10^{-6}	10×10^{-5}	72×10^{-6}				13×10^{-5}
t-value		1.72	2.48	4.04		2.22	2.99	2.34				4.04
Elderly Caseload												
coefficient	79×10^{-3}	95×10^{-3}	11×10^{-2}		12×10^{-2}	15×10^{-2}	22×10^{-2}		98×10^{-3}		13×10^{-2}	
t-value	2.02	2.06	2.49		2.43	2.57	3.70		2.08		2.56	
Nonprofit Control												
coefficient	-12×10^{-3}	-18×10^{-3}	-20×10^{-3}	-27×10^{-3}		-17×10^{-3}	-32×10^{-3}	-27×10^{-3}	-26×10^{-3}	-26×10^{-3}	-20×10^{-3}	-42×10^{-3}
t-value	-1.76	-2.58	-2.73	-3.44		-2.04	-3.54	-2.66	-3.14	-3.00	-2.28	-4.42
Urban												
coefficient	64×10^{-3}	38×10^{-3}	29×10^{-3}		57×10^{-3}	37×10^{-3}	48×10^{-3}		96×10^{-3}	54×10^{-3}	64×10^{-3}	
t-value	4.31	2.32	1.73		3.58	1.91	2.25		4.71	2.89	2.98	
R^2	0.11	0.11	0.14	0.11	0.13	0.16	0.26	0.11	0.15	0.11	0.12	0.15
Determinant	0.53	0.28	0.28	0.86	0.65	0.25	0.22	0.88	0.36	0.61	0.37	0.76
Constant	52×10^{-2}	55×10^{-2}	57×10^{-2}	63×10^{-2}	51×10^{-2}	53×10^{-2}	54×10^{-2}	65×10^{-2}	49×10^{-2}	58×10^{-2}	54×10^{-2}	63×10^{-2}

influence is significant at the .05 level in 1973. In the Michigan results the Program's influence is significant at the .001 level in the middle study years and at close to that level in the end years. In contrast, in the Tristate analyses the Program's impact is significant at the .01 level only in the 1968 equation. Its effect is significant at the .05 level in the 1972 comparison and at almost that level in the 1970 equation. Its influence is thoroughly insignificant in 1973.

Nonprofit control has a consistent negative influence on payroll/cost. Urban population and elderly caseload have positive effects. Bed size also has a positive influence, but its impact is largely confined to the early study years.

Similar to the average salary and capital intensity percentage change analyses, the predictive power of the payroll/cost percentage change analyses is low. As displayed in Table 13-15, the R^2s approximate .09. As with the other resource usage analyses, collinearity involving the Indiana Program is low. The Program's covariance ratio never exceeds .09. Overall collinearity is moderate, with the determinant ranging from .91 to .35.

Table 13-15

PERCENTAGE CHANGE ANALYSES OF PAYROLL/COST

	% Δ 1968-1973		
	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	14×10^{-3}	17×10^{-3}	19×10^{-3}
t-value	1.27	1.21	1.49
% impact	19.5	24.3	27.7
covariance	0.05	0.08	0.09
% Δ Elderly Caseload			
coefficient	57×10^{-3}	14×10^{-2}	
t-value	2.04	2.95	
Bed Size			
coefficient	-14×10^{-5}		-17×10^{-5}
t-value	-3.23		-3.01
Nonprofit Control			
coefficient	26×10^{-3}	27×10^{-3}	35×10^{-3}
t-value	2.20	1.98	2.28
Urban			
coefficient	72×10^{-3}		84×10^{-3}
t-value	2.76		2.30
R^2	0.09	0.09	0.10
Determinant	0.47	0.91	0.35
Constant	-12×10^{-2}	-11×10^{-2}	-13×10^{-2}

In all three equations the effect of the Indiana Program is positive. It is significant at the .10 level in the Tristate comparison and at almost that level in the other two equations.

Analogous to the effect of elderly caseload in the annual analyses, the percentage change in this variable has a positive influence in these analyses. Also consistent with the annual results, nonprofit control and urban population have positive effects on the percentage change in payroll/cost, and bed size has a negative influence.

Effects of Productivity and Resource Usage on Cost

Overall Results

Findings -- Since the productivity and resource usage variables are continuous, the elasticity coefficient is the appropriate statistic for indicating the size of their effects on cost. The elasticity coefficient, stated in this report as a percentage, serves the same function for endogenous variables as the percentage impact statistic does for the Indiana Program Index, a dichotomous variable.

In general, the elasticity coefficient is defined as the percentage change in the dependent variable produced by a given percentage change in an independent variable. The dependent variable in these analyses is total cost. Four productivity and resource usage variables are used as independent variables: labor productivity, capital productivity, average salary, and capital intensity. In these analyses the elasticity coefficient thus indicates the percentage change in total cost expected as a result of a given percentage change in one of these variables. As an example, if labor productivity has a total cost elasticity of 50%, a 10% change in labor productivity would produce a 5% change in cost.

The Program's influence on cost transmitted through an endogenous variable equals the Program's impact on the endogenous variable (shown by the percentage impact statistic) multiplied by the endogenous variable's effect on cost (indicated by the elasticity coefficient). For example, if the Program has a -10% impact on average salary and if the cost elasticity of average salary is +80%, the Program exerts a -8% influence on total cost through its impact on average salary. Consistent with the discussions of earlier chapters, if the Program's impact on the endogenous variable or if the endogenous variable's effect on cost is not significant at least at the .05 level, the transmitting effect of the endogenous variable is shown as a zero in the relevant table.

Labor productivity was expected to have a strong negative influence on total cost. Since the Program was expected to have a positive effect on labor productivity, it was hypothesized that this variable would be an important mechanism transmitting the Program's influence on cost.

The findings substantiate these hypotheses. As displayed in Table 13-16, in the Combined analyses labor productivity exerts a negative influence on total cost in all four study years. Its effect is strongest in 1970, -77%, and weakest in 1973, -56%. Its impact on the percentage change in total cost is -17%. While this seems weaker than its influence in the annual analyses, this is not in fact the case. Instead, the lower elasticity in the percentage change analyses arises because the average percentage change in labor productivity is low and the average percentage change in total cost is high.[2]

Table 13-16

EFFECT OF LABOR PRODUCTIVITY ON TOTAL COST

	COMBINED	MICHIGAN	TRISTATE
1973	-56%	-39%	-72%
1972	-63%	-53%	-77%
1970	-77%	-70%	-76%
1968	-68%	-61%	-67%
% Δ '68-'73	-17%	-16%	-14%

In the Tristate analyses labor productivity's impact on total cost is stable across the four study years, approximating -75%. In the Michigan comparisons labor productivity's impact is distinctly weaker in the later study years, especially in 1973 when its effect is -39%. The influence of labor productivity on the percentage change in cost is similar in the Michigan and Tristate analyses, approximating -15%.

Table 13-17 shows the transmitting effects of labor productivity. It is derived from the findings displayed in Tables 13-1 and 13-16. Specifically,

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[2] The average percentage changes in labor productivity and total cost are -10% (-.10) and +72% (+.72) respectively. The elasticity finding indicates that a 20% decrease in the percentage change in labor productivity would induce a 3.4% increase in the percentage change in total cost. In absolute terms, the 20% change in the labor productivity variable would entail a decrease in its mean from -.10 to -.12 and the 3.4% change in the total cost variable would entail an increase in its mean from .72 to .74.

each data element in this table equals the product of the Program's impact on labor productivity and labor productivity's effect on cost.

Table 13-17

IMPACT OF INDIANA PROGRAM ON TOTAL COST TRANSMITTED THROUGH LABOR PRODUCTIVITY

	COMBINED	MICHIGAN	TRISTATE
1973	-4%	-3%	-6%
1972	-5%	-6%	-5%
1970	-3%	-6%	0
1968	0	0	0
% Δ	-8%	-7%	-8%

As indicated in this table, in the Combined analyses the Program's impact on cost transmitted through labor productivity is strongest in the later study years, equalling -4% in 1973 and -5% in 1972. In 1970 the transmitting effect is -3%, which reflects the strong influence of labor productivity on cost in that year. The transmitting influence of labor productivity is insignificant in 1968, because the Program's impact on labor productivity is insignificant in that year. Consistent with the annual results, the Program exerts a -8% influence on the percentage change in cost through its impact on the percentage change in labor productivity.

In the Michigan and Tristate analyses the transmitting influence of labor productivity is negative in the later years. In 1972 it is slightly higher in the Michigan analyses. However, in 1973 it is distinctly higher in the Tristate comparisons because of the relatively weak cost effect of labor productivity in the Michigan analysis. In the early years the transmitting influence of labor productivity is only significant in the 1970 Michigan comparison, equalling -6%. In the percentage change analyses the transmitting effect of labor productivity is similar in the Michigan and Tristate comparisons, approximating -8%.

It was hypothesized that capital productivity would have a weakly negative or insignificant impact on cost. Accordingly, although the Program was expected to have a positive influence on capital productivity, this variable was not expected to be a mechanism appreciably transmitting the Program's impact on cost.

The findings are supportive of these hypotheses. As displayed in Table 13-18, only in 1970 is capital productivity's effect on cost significant in the Combined analyses. In that year it equals -21%. The Michigan findings are almost precisely the same as the Combined results, with capital productivity's effect equalling -22% in the 1970 Michigan comparison. In the Tristate analyses capital productivity's influence is insignificant in both later years as is its impact on the percentage change in cost. However, it has a negative impact approximating -20% in the early study years.

Table 13-18

EFFECT OF CAPITAL PRODUCTIVITY ON TOTAL COST

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1972	0	0	0
1970	-21%	-22%	-20%
1968	0	0	-18%
% Δ '68-'73	0	0	0

As shown in Table 13-19, in the Combined analyses the transmitting effect of capital productivity is insignificant in all four study years as is its transmitting influence on the percentage change in cost. These findings arise both because of capital productivity's weak effect on cost and because of the Program's inconsistent influence on capital productivity. In the Tristate analyses the transmitting effect of capital productivity is similarly insignificant in all study time periods. Almost the same results were obtained in the Michigan analyses. In these analyses the transmitting effect of capital productivity is significant only in 1970, when it equals -1%. This is still far lower than the transmitting influence of labor productivity in the same year, -6%.

Table 13-19

IMPACT OF INDIANA PROGRAM ON TOTAL COST
TRANSMITTED THROUGH CAPITAL PRODUCTIVITY

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1972	0	0	0
1970	0	-1%	0
1968	0	0	0
% Δ '68-'73	0	0	0

It was hypothesized that average salary would have a strong positive impact on cost. Since the Program was expected to have a negative influence on average salary, it was postulated that this variable would be an important mechanism transmitting the Program's influence on cost.

The results corroborate these hypotheses. As shown in Table 13-20, in the Combined analyses average salary exerts a strong positive influence on cost in all study years. This effect is stable across the study period, equalling +86% in 1973 and +82% in 1968. Average salary's influence on the percentage change in cost is also strongly positive, equalling +43%. The divergence between the size of this effect and

Table 13-20

EFFECT OF AVERAGE SALARY ON TOTAL COST

	COMBINED	MICHIGAN	TRISTATE
1973	+86%	+84%	+81%
1972	+74%	+74%	+64%
1970	+91%	+89%	+84%
1968	+82%	+76%	+71%
% Δ '68-'73	+43%	+40%	+44%

the magnitude of average salary's influence in the annual analyses is again due to the difference between the means of the percentage change variables.[3]

There is a close resemblance between the Michigan and Tristate findings. In 1973 average salary's effect on cost is +84% and +81% in the Michigan and Tristate comparisons respectively. The greatest divergence occurs in 1972 when average salary's effect is +74% in the Michigan analyses and +64% in the Tristate analyses, but even this difference is modest. Similarly, average salary's impact on the percentage change in cost is approximately the same in these analyses, equalling +40% in the Michigan comparisons and +44% in the Tristate analyses.

As displayed in Table 13-21, in the Combined analyses the transmitting effect of average salary is almost constant during the study period. It equals -7% in 1973, 1972, and 1968, dipping to -5% in 1970.

Table 13-21

IMPACT OF INDIANA PROGRAM ON TOTAL COST
TRANSMITTED THROUGH AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
1973	-7%	-10%	-3%
1972	-7%	-10%	-4%
1970	-5%	-9%	-3%
1968	-7%	-7%	-5%
% Δ '68-'73	0	-6%	0

The Tristate findings present a somewhat similar pattern. Average salary's transmitting influence is highest in 1968 and 1972, -5% and -4% respectively. It equals -3% in the other years. As in the Combined analyses, its transmitting effect on the percentage change in cost is insignificant. In contrast, the transmitting impact of average salary

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[3] In this instance the difference is not as great as it is for labor productivity. The average change in average salary is 40% compared to the average 72% increase in total cost.

steadily increases in the Michigan analyses. It equals -7% in 1968, increases to -9% in 1970, then rises to -10% in 1972 and 1973. Accordingly, its transmitting effect on the percentage change in cost is significant, -6%.

It was hypothesized that capital intensity would have a positive impact on cost. The Indiana system was expected to have an insignificant influence on capital intensity in the Tristate and Combined analyses, but the Michigan program was expected to increase capital intensity. Consequently, capital intensity was anticipated to be a mechanism partially responsible for cost differences between Indiana and control hospitals, but only in the Michigan analyses.

These hypotheses are partially substantiated by the results. In the Combined analyses capital intensity has a positive impact on cost which remains steady during the study years, analogous to the influence of average salary. As displayed in Table 13-22, the effect of capital intensity equals +11% in all study years except 1970 when it falls to +8%. The influence of capital intensity on the percentage change in cost is +6%.

Table 13-22

EFFECT OF CAPITAL INTENSITY ON TOTAL COST

	COMBINED	MICHIGAN	TRISTATE
1973	+11%	+9%	+7%
1972	+11%	+7%	+10%
1970	+8%	+4%	+11%
1968	+11%	+12%	+9%
% Δ '68-'73	+6%	+6%	+4%

In the Tristate analyses capital intensity's influence on cost also remains relatively constant during the study period. It is highest in the two middle years equalling +11% and +10% in 1970 and 1972 respectively. It is lowest in 1973, +7%. The influence of capital intensity on the percentage change in cost is +4%. In contrast to the other analyses, marked fluctuations characterize capital intensity's cost effect in the Michigan comparisons. This effect is +12% in 1968, falling to +4% in 1970, then rising to +7% in 1972 and +9% in 1973. Capital intensity's impact on the percentage change in cost is the same in the Michigan results as in the Combined findings, +6%.

As shown in Table 13-23, in both the Tristate and Combined analyses the transmitting effect of capital intensity is insignificant in all four study years and in the percentage change analyses. These findings arise not because the cost influence of capital intensity is weak, but because the Program's impact on capital intensity is insignificant in all study periods.

Table 13-23

IMPACT OF INDIANA PROGRAM ON TOTAL COST
TRANSMITTED THROUGH CAPITAL INTENSITY

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1972	0	0	0
1970	0	0	0
1968	0	+2%	0
% Δ '68-'73	0	-3%	0

In the Michigan analyses the transmitting influence of capital intensity is also insignificant in the last three study years. It is significant in 1968, but it is positive rather than negative, equalling +2%. Capital intensity's transmitting effect is also significant in the percentage change analyses, with its sign being negative in this instance, -3%.

Interpretation -- These findings establish that average salary and labor productivity are both important pathways for the Program's cost influence. However, reflecting the Program's dissimilar effects over time on these variables, they play distinctly different roles in transmitting the Program's cost influence. Average salary's transmitting effect is steady across the study period. The Program's impact on average salary establishes a firm baseline for its impact on cost. Even without a labor productivity or other effect, the Program's influence on average salary is in itself sufficient to produce a negative impact on cost.

However, the very stability of the average salary effect means that it is only modestly responsible for the Indiana system's accelerating

impact on cost. That is, the average salary effect does not significantly enhance the Program's increasing percentage impact on cost, but it does contribute to the Program's rising dollar impact on cost.

In contrast, the Program's increasing influence on labor productivity strengthens its cost impact in both percentage and dollar terms. In 1968 none of the Program's cost impact is conveyed through labor productivity. In 1973 a sizeable influence is transmitted through this variable.

These analyses also confirm that capital intensity and capital productivity do not appreciably transmit the Program's influence on cost. This conclusion had been strongly suggested by earlier results. Even so, the Program's inconclusive effects on these capital variables stand in sharp contrast to its penetrating influence on the labor variables.

Detailed Findings

The predictive power of the Step C total cost annual analyses is high. As indicated in Table 13-24, the R^2s range narrowly from .90 to .78. They approximate .85 in the Combined equations with the exception of the 1972 comparison, in which the R^2 is .78. Collinearity is substantial, but not sufficiently high to present analytical difficulties. The determinant ranges from .78 to .16.

The negative effect of labor productivity is significant at the .001 level in all these equations. Similarly, the positive impact of average salary is significant at that level throughout these analyses. In all the Combined and Tristate analyses and in the 1973 and 1968 Michigan equations, the positive influence of capital intensity is significant at the .001 level. However, in the two middle years of the Michigan comparisons the effect of capital intensity is significant at the .05 level. The negative influence of capital productivity is significant at the .001 level in the 1970 and 1968 Tristate equations and in the 1970 Combined comparison. It is significant at the .01 level in the 1970 Michigan equation, but in the rest of the analyses its impact is insignificant.

Three semi-exogenous variables are determinants of total cost in these analyses. The strongest of these is length of stay, which has a positive influence. Elderly caseload has a negative impact and emergency/outpatient involvement a positive influence.

Table 13-24

STEP C ANNUAL ANALYSES OF TOTAL COST

	COMBINED				MICHIGAN				TRISTATE			
	1973	1972	1970	1968	1973	1972	1970	1968	1973	1972	1970	1968
Average Salary												
coefficient	92×10^{-3}	75×10^{-3}	84×10^{-3}	71×10^{-3}	91×10^{-3}	76×10^{-3}	83×10^{-3}	67×10^{-3}	82×10^{-3}	62×10^{-3}	75×10^{-3}	60×10^{-3}
t-value	14.00	9.97	16.99	16.30	11.07	8.11	12.74	11.85	13.11	8.47	15.59	14.11
% elasticity	85.9	74.3	90.8	81.9	84.0	73.7	88.7	75.8	81.2	63.7	84.2	70.8
Labor Productivity												
coefficient	-25×10^{0}	-24×10^{0}	-23×10^{0}	-16×10^{0}	-18×10^{0}	-21×10^{0}	-22×10^{0}	-14×10^{0}	-27×10^{0}	-26×10^{0}	-20×10^{0}	-14×10^{0}
t-value	-10.03	-9.12	-15.26	-16.00	-5.23	-6.14	-9.99	-10.77	-13.16	-10.26	-16.42	-14.84
% elasticity	-56.2	-63.0	-76.9	-68.2	-38.9	-52.6	-69.8	-60.7	-71.8	-76.7	-75.6	-67.1
Capital Intensity												
coefficient	34×10^{-4}	32×10^{-4}	21×10^{-4}	29×10^{-4}	30×10^{-4}	23×10^{-4}	12×10^{-4}	33×10^{-4}	19×10^{-4}	28×10^{-4}	28×10^{-4}	21×10^{-4}
t-value	5.67	4.57	4.40	6.81	3.23	2.15	1.77	5.53	3.92	4.70	6.65	5.60
% elasticity	11.0	11.0	7.6	11.4	9.1	7.4	4.2	12.2	6.8	10.4	10.7	9.3
Capital Productivity												
coefficient			-32×10^{-1}				-34×10^{-1}				-28×10^{-1}	-20×10^{-1}
t-value			-3.23				-2.55				-3.54	-3.39
% elasticity			-21.0				-22.0				-20.3	-18.1
Length of Stay												
coefficient	54×10^{0}	47×10^{0}	16×10^{0}	27×10^{0}	73×10^{0}	47×10^{0}	17×10^{0}	34×10^{0}	24×10^{0}	38×10^{0}	16×10^{0}	14×10^{0}
t-value	6.96	5.33	3.07	9.18	6.80	4.10	2.14	8.16	3.33	4.77	3.81	4.52
% elasticity	53.2	51.9	22.6	49.2	72.4	52.0	23.4	61.1	25.2	44.6	24.2	26.6
Emergency/Outpatient												
coefficient	46×10^{1}			20×10^{1}	85×10^{1}	56×10^{1}		25×10^{1}	29×10^{1}		32×10^{1}	
t-value	2.95			1.97	3.58	1.79		1.73	2.02		3.25	
% elasticity	6.4			3.4	12.6	8.2		4.4	4.0		4.6	
Elderly Caseload												
coefficient	-19×10^{1}	-21×10^{1}	-23×10^{1}	-11×10^{1}	-36×10^{1}	-39×10^{1}	-37×10^{1}	-26×10^{1}			-15×10^{1}	-95×10^{0}
t-value	-2.24	-2.13	-3.88	-2.82	-3.10	-3.06	-4.43	-4.61			-3.20	-2.77
% elasticity	-9.5	-11.2	-15.0	-9.3	-17.4	-20.2	-23.0	-21.3			-11.0	-8.9
R^2	0.84	0.78	0.86	0.86	0.84	0.79	0.86	0.87	0.85	0.81	0.90	0.88
Determinant	0.33	0.33	0.19	0.44	0.23	0.22	0.16	0.78	0.40	0.39	0.20	0.22
Constant	70×10^{0}	25×10^{1}	51×10^{1}	14×10^{1}	-17×10^{1}	22×10^{1}	57×10^{1}	13×10^{1}	37×10^{1}	36×10^{1}	43×10^{1}	37×10^{1}

The predictive power of the Step C total cost percentage change analyses is also high, although modestly lower than that of the Step C annual analyses. As shown in Table 13-25, the R^2s range from .81 in the Combined equation to .74 in the Tristate comparison. Overall collinearity is modest, with the determinant approximating .40.

Table 13-25

STEP C PERCENTAGE CHANGE ANALYSES OF TOTAL COST

	COMBINED	MICHIGAN	TRISTATE
% Δ Average Salary			
coefficient	76×10^{-2}	70×10^{-2}	76×10^{-2}
t-value	12.41	9.49	8.59
% elasticity	42.7	39.6	43.9
% Δ Labor Productivity			
coefficient	-12×10^{-1}	-12×10^{-1}	-11×10^{-1}
t-value	-15.67	-11.61	-10.90
% elasticity	-16.8	-15.9	-13.5
% Δ Capital Intensity			
coefficient	69×10^{-3}	60×10^{-3}	53×10^{-3}
t-value	8.72	6.39	4.76
% elasticity	6.1	5.6	4.3
% Δ Length of Stay			
coefficient	81×10^{-2}	93×10^{-2}	78×10^{-2}
t-value	9.04	8.18	6.47
% elasticity	6.2	4.2	7.9
% Δ ECF Involvement			
coefficient	45×10^{-4}	51×10^{-4}	39×10^{-4}
t-value	4.27	3.90	2.41
% elasticity	1.4	1.7	1.0
% Δ Emergency/Outpatient			
coefficient	10×10^{-2}	93×10^{-3}	41×10^{-3}
t-value	5.87	4.65	1.89
% elasticity	7.1	6.8	3.4
R^2	0.81	0.80	0.74
Determinant	0.41	0.41	0.37
Constant	23×10^{-2}	26×10^{-2}	27×10^{-2}

The positive impact of the percentage change in average salary is significant at the .001 level in all three equations. The same is true for the negative influence of the percentage change in labor productivity and for the positive effect of the percentage change in capital intensity. In contrast, the percentage change in capital productivity has an insignificant impact in these equations.

Analogous to the annual analyses, the percentage change in length of stay is the strongest determinant among the semi-exogenous variables. It has a positive influence in all three equations. The percentage changes in emergency/outpatient involvement and ECF involvement also have positive effects throughout these analyses.

V.

Segment II: Influence on Resource Use and Financial Position

The primary purpose of Segment II is to pursue the second study objective. It addresses the questions: How does the Indiana system achieve its cost effect? Which variables serve as pathways for the Program's cost influence? To answer these questions, this segment builds upon the earlier results and analyzes the Indiana system's effects on component costs, labor usage, and capital usage. It also determines the Program's impact on shared/contracted services.

The other purpose of this segment is to begin the analyses pursuant to the third study objective. In this role the segment determines whether the Indiana system drains hospital financial resources -- a serious side effect if present.

This segment uses the Project Survey in addition to the Segment I data sources -- an action with two consequences. One is that important variables not examined in Segment I can now be analyzed. The other is that the Segment II sample is smaller than the main study sample, containing approximately 60% of the study hospitals. However, the reduction in sample size does not have unfavorable ramifications since the Segment II sample is highly comparable to both the main study sample and the Indiana hospital universe. The findings of this segment are thus generalizable to that universe.

The Segment II results are based entirely on regression analysis. The main study time period (1968 through 1973) is utilized in this segment, but unlike Segment I, only data pertaining to the end years of this span is analyzed. The four chapters of this section are analogous to those of the preceding section.

14.
Expected Impact of the Program

This chapter uses the same format and is based upon the same principles as its analogue, Chapter 10. Underlying its discussions will be the thesis demonstrated in the Segment I analysis: The Indiana Program has a stronger impact in 1973 than in 1968.

In this chapter, as in Chapter 10, each endogenous variable is defined; the importance of each variable is examined; and the expected effects of the Indiana Program on each variable are discussed. The hypotheses specifying such effects are derived in terms of 1968 and 1973 -- the only years included in Segment II -- as well as in terms of the percentage change between these years. Each hypothesis is to be interpreted both in a multivariate context and as showing expected statistical significance at the .05 level.

Component Costs

Definition

In these analyses, total cost is divided into three mutually exclusive components. One is labor cost, which is composed entirely of salary and wage expenses. Another is capital cost, which primarily consists of depreciation and interest expenses. The third is supply/service cost, the least homogeneous of the component costs. It includes such disparate costs as those for drugs, housekeeping supplies, raw food, and data processing services.

Importance

Each component cost represents a major type of resources used by hospitals. Even though supply/service cost is more heterogeneous than the other two costs, it is still directed toward resources distinctly different from labor and capital. Analysis of the component costs is thus an integral part of the effort to determine the pathways of the Program's cost influence. Using capital cost as an example, if the Program does not have a significant influence on this cost, its effects on the capital use variables must be either insignificant or mutually offsetting. The same logic applies to the other component costs.

The objectives of the component cost analyses are twofold. The first is to determine the magnitude of the Indiana Program's negative impact on labor cost -- an impact implied, but not directly estimated, by the Segment I analyses. The second is to determine the Program's effects on supply/service and capital costs -- issues largely outside the scope of Segment I.

Effects of Indiana Program

A dominant feature of the Indiana Program has been application of balanced pressure to hospitals. On the basis of Program characteristics alone, there is no reason to suspect differential effects on the component costs. However, as with the departmental costs, the nature of the component costs makes it likely that differential effects will exist.

Any cost equals the unit prices of the inputs included in the cost multiplied by the quantities of those inputs. As emphasized earlier, the hospital is a large employer in many of its labor markets. Hence, it can significantly influence the wage rates of some of its personnel, especially those with specialized health skills. Conversely, the hospital is small relative to most of its supply/service and capital markets. As a consequence, it can exert little influence on supply/service or capital prices. For example, the hospital has essentially no control over the prices of x-ray machines or electricity. An exception to this principle is that the hospital may be able to modestly influence drug and supply prices through individual negotiations or joint purchasing arrangements.

In general, the hospital administrative staff has less personal stake in supplies and services than in labor or capital. It is thus less painful for the administrative staff to cut supplies and services than labor or capital, in terms of actual reductions, decreases in planned expansions, or downward shifts in the quality mix of inputs. Equally significant, many supply/service areas are peripheral to the main concerns of the physician staff. Reductions in supplies and services will usually encounter less physician opposition than will decreases in labor or capital. As a consequence of these factors, in response to the Program's cost pressure, a hospital will often elect, for example, to reduce its outlays for food or housekeeping supplies before it lays off personnel or cuts back specialized equipment purchases.

The expected differential effects of the Indiana Program on the quantities of the three components are thus not the same as its expected differential effects on the components' prices. That is, labor prices are likely to be more sensitive than supply/service or capital prices to hospital actions, while hospitals will probably reduce supply/service quantities more sharply than labor or capital quantities in response to financial pressure. Although both differential effects are probably important, the magnitude of the differential price effect is likely to be substantially greater. As a result, the Indiana Program will have its strongest influence on labor cost, its next highest impact on supply/service cost, and its least powerful effect on capital cost. Even so, because of its specific scrutiny of capital usage, the Program is expected to have a negative impact on capital cost. As with total and departmental costs, the Program's influence on the component costs is likely to be substantially higher in 1973 than in 1968.

The Michigan planning program is directed exclusively toward capital usage. Consequently, it may not only decrease such usage, but it may also induce increased utilization of supply/service and especially labor inputs. The negative influence of the Indiana Program on capital costs is thus likely to be lower in the Michigan analysis than in the Tristate analysis. Conversely, the impact of the Indiana Program on labor and supply/service costs is probably higher in the Michigan analysis. However, because capital cost is a small component of total cost, the latter effects will be much weaker than the former effect. That is, even if the Michigan program has a substantial impact on capital usage, its spillover effects on labor and supply/service usage may be minimal.

In summary, the following hypotheses will be tested in this area.

(1) The Indiana Program will have a strong negative impact on labor cost in 1973, a weaker negative impact on labor cost in 1968, and a negative impact on the percentage change in such cost between these years.

(2) The Indiana Program will have a negative influence on supply/service cost in 1973, a weakly negative or insignificant impact on such cost in 1968, and a negative effect on the percentage change in such cost between these years. Its impact on supply/service cost will be less strong than its influence on labor cost.

(3) The Indiana Program will have a negative impact on capital cost in 1973, a weakly negative or insignificant influence on such cost in 1968, and a negative impact on the percentage change in such cost between these years. Its influence on capital cost will be less powerful than its effects on either labor or supply/service costs. Further, its impact on capital cost will be greater in the Tristate analyses than in the Michigan analyses.

Labor Usage

Definition

Three new labor usage variables are included in Segment II. One is wage level which indicates the level of hospital wage rates. The second is skill mix which represents the mixture of hospital personnel skills. The third variable is unionization which depicts the extent to which hospital personnel are unionized.

As described in Chapter 15, because of data limitations these three variables are based exclusively on the three main nursing categories: registered nurse (RN), licensed practical nurse (LPN), and nurses' aide/orderly (NA). These variables are thus not hospital-wide measures

as are average salary and labor productivity. However, the centrality of nursing personnel in the hospital makes it likely that these variables closely reflect conditions throughout the institution. For example, if the wage rates of nurses' aides are relatively high, so will be the wage rates of food service helpers or laundry workers. The same point holds for skill mix and unionization, although perhaps to a somewhat lesser extent.

Importance

The Segment I analyses show that average salary and labor productivity are the endogenous variables transmitting the negative influence of the Indiana Program on total cost. Further, in all study years a greater fraction of the Program's influence is transmitted through average salary than through labor productivity. The main purpose of these Segment II analyses is to determine whether the Program's impact on average salary is transmitted through wage level, skill mix, or both. That is, does the Indiana Program reduce wage level and thus decrease average salary? Or, does it lower skill mix and thus decrease average salary? Or does it have both effects?

Average salary is determined by the wage levels and mixture of different personnel types. In fact, if wage level and skill mix were hospital-wide measures and if the personnel categories were subdivided finely enough, average salary would precisely equal the product of wage level and skill mix. As noted earlier, this is not the case in this study. Even so, it is expected that wage level and skill mix (as measured in this study) will have positive effects on average salary, which will be sufficiently powerful to permit the determination of the extent to which these variables transmit the Program's influence on average salary.

The second purpose of these analyses is to determine whether the Indiana Program has a negative impact on unionization. This objective is important for two reasons. First, such a determination is of substantive interest since unionization is a controversial factor in the hospital industry. Second, given the first point, it is useful to determine to what extent a possible negative effect of the Indiana Program on wage level is transmitted through unionization. In other words, presuming a negative effect on wage level, does the Indiana Program lower wage level, and thereby average salary and total cost, mainly by reducing unionization?

Effects of Indiana Program

The Indiana Program carefully scrutinizes each hospital's wage schedule, concentrating on the wage rates for the benchmark personnel categories, but also questioning at times the wage rates for other personnel categories. As discussed earlier, the hospital is a large employer in many of its labor markets. It can therefore influence the wage rates of many employees. Because of these complementary factors -- the Program's

scrutiny of wage rates and the sensitivity of wage rates to hospital actions -- the Indiana system is likely to have a negative influence on wage level.

The Indiana Program also systematically reviews the skill mix used by hospitals -- another variable under the direct control of the administrative staff. As a result of this combination of factors, the Program is likely to have a negative impact on skill mix, although its effect on this variable will probably not be as strong as its impact on wage level. The Program's influence on skill mix is likely to be facilitated by the insufficient downward delegation which often exists in the hospital field as well as in other health care areas. As a consequence, if a hospital systematically experiments with skill mix combinations in response to the Program's cost pressure, it may often conclude that efficiency can be improved by decreasing skill mix.

The same result may occur if attrition produces changes in skill mix. For example, a registered nurse may resign and be replaced by a licensed practical nurse or by a nurses' aide on an interim basis. The hospital may find that the new skill mix combination is as productive as the previous one, and may therefore retain it permanently.

Both wage level and skill mix are expected to have positive effects on average salary; these effects will probably be of approximately the same magnitude. Hence, because the Program is expected to have a moderately stronger influence on wage level than on skill mix, the former is expected to be somewhat more important than the latter in transmitting the Program's influence on average salary.

The Indiana Program itself has remained neutral on hospital unionization. It has neither explicitly encouraged nor discouraged unionization. For many years an officer of the Indiana AFL-CIO has been an RRC member, which makes an overt anti-unionization posture difficult. However, the Program intensifies the degree of cost pressure felt by the hospital, which alters the latter's response to unionization attempts. In general, the greater the cost pressure, the stronger will be the hospital's resistance to unionization.

Contributing to the Program's impact on unionization are the activities of the Indiana Hospital Association, which carefully monitors union activity and advises hospitals about how best to react to such activity. Its efforts range from general educational programs about unionization to technical assistance for hospitals faced with specific unionization attempts. An important theme of IHA's work in this area is the development of positive personnel policies by hospitals.

It is difficult to divorce the unionization impact of the Program from the unionization effect of IHA. As emphasized earlier, involvement by IHA is an essential ingredient in the Indiana Program. It is possible that the expected lower unionization of Indiana hospitals is primarily due to IHA activities. However, it seems likely that similar hospital association activities would be less successful in a state without a prospective rate setting program similar to Indiana's. If nothing else,

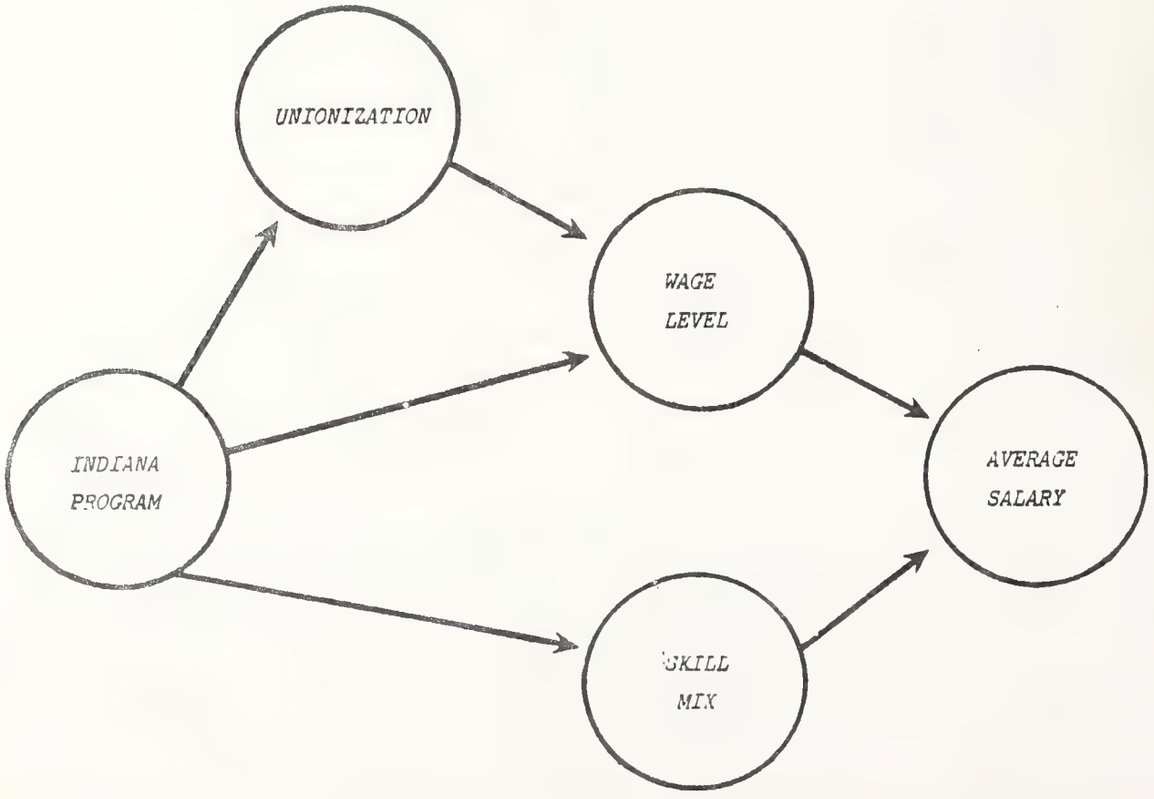
the Program increases IHA's clout in Indiana and serves as a point of economic coalescence for Indiana hospitals. It is therefore appropriate to consider the expected lower unionization of Indiana hospitals an effect of the Indiana Program. Similarly, in the interpretation of this expected result it is essential to note IHA's contribution.

Unionization is only one of the factors influencing wage level, although it is expected to have a positive impact. Even if the hospital industry were totally unionized, a prospective rate setting program would still have the capacity to lower wage rates by inducing hospital administrators to more strongly contest union demands. Further, unionization is not widespread in the hospital industry, at least in the Midwest. It is thus likely that a significant fraction, but distinctly less than one half, of the Program's effect on wage level is transmitted through unionization.

Because of their complexity, these labor usage analyses are schematically depicted in Figure 14-1. Each relationship represented in this figure by a solid arrow is tested in these analyses. This figure also makes it clear that the approach used here for analyzing the extent to which wage level and skill mix transmit the Program's effect on average salary is analogous to that employed in Segment I for determining the extent to which average salary, labor productivity, and other endogenous variables transmit the Program's influence on total cost. The same point also applies to the analyses directed toward determining the extent to which unionization transmits the Program's possible impact on wage level.

Figure 14-1

SCHEMATIC MODEL FOR THE LABOR USAGE ANALYSES



In summary, the following hypotheses will be tested in this area.

(4) The Indiana Program will have a strong negative impact on wage level in 1973, a weaker negative influence on this variable in 1968, and a negative effect on the percentage change in wage level between these years.

(5) The Indiana Program will have a negative effect on skill mix in 1973, a weaker negative impact on this variable in 1968, and a negative influence on the percentage change in this variable between these years.

(6) Both wage level and skill mix will have strong positive effects on average salary. Both variables will thus transmit the Program's influence on average salary, but wage level will be somewhat more important in this regard because of the Program's moderately stronger influence on this variable.

(7) The Indiana Program will have a negative impact on unionization in 1973, a weaker negative influence on this variable in 1968, and a negative effect on the percentage change in this variable between these years.

(8) Unionization will have a positive influence on wage level. As a partial consequence, an appreciable fraction, but substantially less than the majority, of the Indiana Program's effect on wage level will be transmitted through unionization.

Capital Usage

Definition

Two dimensions of capital usage are examined in Segment II. The first is capital expenditures, defined as capital outlays for substantial projects completed between 1968 and 1973. The second is the percentage change in bed size between 1968 and 1973. As discussed in Chapter 8, bed size in 1968 and 1973 must be considered a semi-exogenous variable. It therefore cannot be analyzed as an endogenous variable in these analyses.

Importance

In Segment I the Indiana Program's influence on capital intensity is insignificant in the Tristate and Combined analyses. In partial contrast, in the Michigan comparisons Indiana hospitals display higher capital intensity in 1968. In the other study years there is no significant difference between Michigan and Indiana hospitals in terms of this variable. Correspondingly, the percentage increase in capital intensity is lower in Indiana hospitals than in Michigan hospitals. As discussed earlier, the latter result is probably due primarily to the Michigan planning program.

The Segment I results thus support the thesis that the Indiana Program maintains a balanced stance in its review of capital usage. That is, it neither increases nor decreases the intensity of capital resources. However, the Segment I findings do not indicate whether the Indiana Program decreases cost by constraining capital expenditures. The purpose of these analyses is to respond to this question in terms of both capital expenditures themselves and the percentage change in bed size (i.e., the magnitude of the basic hospital plant).

Effects of Indiana Program

Reliance upon regional planning and capital expenditures review has been a central element in the Indiana Program since its inception. The Tristate control group is characterized by weak or nonexistent planning programs. It is therefore likely that in the Tristate analyses the Indiana Program will have a negative impact on both capital expenditures and the percentage change in bed size.

The Segment I finding that the Indiana Program has an insignificant influence on the percentage change in capital intensity reduces to a modest extent the likelihood of these effects. However, it does not rule out either effect, since the percentage change in capital intensity is expected to have only moderate positive correlations with capital expenditures and the percentage change in bed size.

The Michigan and Indiana planning programs were instituted at approximately the same time. Both continued to operate through the last main study year, 1973. There is no solid evidence suggesting that the intensity of capital expenditures review was significantly different in the two states. The Indiana Program is therefore likely to have an insignificant influence on capital expenditures in the Michigan analyses.

However, the Michigan program concentrates to a greater extent on changes in bed size than does the Indiana Program. It is thus likely that compared to Indiana hospitals, Michigan hospitals will exhibit a lower percentage increase in bed size, even though the capital expenditures of the two sets of hospitals will not be significantly different. These expected findings are consistent with the Segment I result that Michigan hospitals are characterized by a higher percentage increase in capital intensity than are Indiana hospitals.

The Combined analyses will reflect the Michigan and Tristate results. It thus seems likely that in these analyses the Program's impact on capital expenditures is weakly negative or insignificant and its effect on the percentage change in bed size is insignificant.

In summary, the following hypotheses will be tested in this area.

(9) In the Tristate analyses the Indiana Program will have negative effects on both capital expenditures and the percentage change in bed size.

(10) In the Michigan analyses the Indiana Program will have an insignificant impact on capital expenditures, but a positive influence on the percentage change in bed size. However, the latter result will be produced by the Michigan program, not by the Indiana system.

(11) In the Combined analyses the Indiana Program will have a modestly negative or insignificant impact on capital expenditures, and an insignificant influence on the percentage change in bed size.

Financial Position

Definition

Three variables are employed in this study to assess hospital financial position. One is net worth which describes the wealth position of the hospital taking into account all assets and liabilities. Another is working capital which characterizes the ability of the hospital to readily meet its current obligations. The third is profit margin which indicates the profitability of the hospital.

The most valid indicator of hospital financial status is net worth. This variable is somewhat sensitive to accounting differences among hospitals, primarily in terms of the valuation of long-term assets. However, it represents the ultimate bottom line in terms of assessing the hospital's financial position at any given time. As such, it is the least sensitive to idiosyncratic variations in hospital financial circumstances which are of little real consequence.

Among these three variables profit margin is the least accurate indicator of true financial status. It is measured across a given fiscal year, while working capital and net worth are measured at the end of that year. Hence, unlike working capital and especially net worth, profit margin directly reflects the hospital's experience during only a single year, which may differ dramatically from its experience during preceding or succeeding years.

Two other factors further diminish the significance of profit margin as an indicator of hospital financial position. First, almost all study hospitals are nonprofit institutions (either private or governmental). This does not mean that they are not mindful of profits and losses. However, since hospital profits do not flow directly to hospital administrators nor do hospitals have common stock whose price reflects profit levels, hospital management is more likely to explicitly or implicitly channel actual profits back into the institution, thereby reducing paper profits.

Second, hospitals can raise funds from sources not available to private industry, such as personal contributions and tax allocations. As a consequence, they are less dependent on present profits for the generation of future funds.

Importance

Assessment of hospital financial position is important since a sound position is generally desirable. This point holds not only from the viewpoint of the hospital industry, but also from a broader public policy standpoint. The objective of prospective rate setting is to control hospital costs, not to weaken hospital financial position. Serious erosion of hospital financial status is likely to have three untoward effects. First, managerial and other resources will be devoted to financial crisis management by hospitals, and to a lesser extent, by the program. Second, especially if they feel program actions are arbitrary, hospitals will sue the program -- an action which not only consumes resources but also interferes with the smooth functioning of the program. Third, if financial damage is severe, the ability of hospitals to deliver care will be impaired.

It is therefore ideal for a prospective rate setting program to decrease hospital costs without weakening hospital financial position. Earlier analyses demonstrate that the Indiana Program achieves the first half of this goal; the objective of these analyses is to determine if the Indiana system attains the other half. That is, does the Program have an inappreciable impact on hospital financial status?

These analyses thus illuminate the Program's impact on a crucial dimension of hospital operations not explored in Segment I. Further, the experience of the New York program illustrates that it is not simply a hypothetical possibility for a prospective rate setting program to damage hospital financial status. It is frequently alleged that the New York program has seriously weakened hospital financial position. While Dowling et al. (1976a and 1976b) did not use regression analysis to examine this possible effect, they did construct an array of indicators to evaluate the financial position of New York hospitals. They concluded that the New York program "definitely contributed to the financial problems of Downstate New York hospitals, although it is not the only contributing factor."

Effects of Indiana Program

While the Indiana system places financial pressure on hospitals, it stresses cooperation rather than strife. It recognizes what it considers the full financial requirements of hospitals as community institutions. Its limited term rate is designed to cover temporary shortages in operating or capital funds. Most important, the hospital's working capital position is explicitly considered by the Program in determining prospective rates.

It is thus unlikely that the Indiana Program sharply reduces hospital financial position. It is possible that the Program modestly decreases financial position because of the financial constraints placed on hospitals. However, it seems more likely that the Program has an insignificant influence on financial position. This expectation applies to all three financial position variables -- net worth, working capital, and profit margin. That is, there is no reason to suspect

that the Indiana system has one effect on one of these variables and a different effect on the other two variables.

In summary, the following hypotheses will be tested in this area.

(12) The Indiana Program will have an insignificant influence on net worth in 1973 and 1968, and on the percentage change in this variable between these years.

(13) The Indiana Program will have an insignificant impact on working capital in 1973 and 1968, and on the percentage change in this variable between these years.

(14) The Indiana Program will have an insignificant effect on profit margin in 1973 and 1968, and on the percentage change in this variable between these years.

Shared/Contracted Services

Definition

This analysis considers a new factor -- the sharing/contracting of services by hospitals. During the study period, there was little sharing of medical services among project hospitals. For example, in 1968 only one study hospital had an explicit agreement with another hospital under which one hospital provides all the pediatric care and the other hospital all the obstetric care. In 1973 only four hospitals had such agreements. Hence, the sharing of medical services was eliminated as a subject for these analyses.

In the nonmedical area three services stand out as being the most frequently shared or contracted by study hospitals -- laundry, dietary, and purchasing. The shared/contracted service variable is consequently based on these services. Both contracting and sharing are included in this variable, since either results in an increase in the scale of operation. This point is clear for shared services, and is equally true for contracted services. For example, if a hospital contracts with a laundry firm, its laundry will be processed at a larger scale of operation than if it performed this task itself.

Importance

During the last quarter century, especially in the last decade, emphasis has been placed on shared/contracted services as one technique for reducing cost. For example, Public Law 93-641 specifically calls for "the development of multi-institutional arrangements for the sharing of support services necessary to all health service institutions."

The common rationale for the expected cost savings resulting from sharing/contracting is that per unit expenses will decline as the scale

of operation increases. That is, it is argued (frequently with justification) that there are significant economies of size in the provision of many hospital services. In this regard the three services used in this study -- laundry, dietary, and purchasing -- have been frequently spotlighted.

The purpose of these analyses is to determine whether the Indiana Program influences the prevalence of shared/contracted services, and by extension, whether it reduces cost in part by increasing sharing/contracting.

Effects of Indiana Program

The Indiana Program has not emphasized sharing/contracting to an appreciably greater extent than have hospital associations and other organizations in the control states. However, the cost pressures exerted by the Indiana Program may lead hospitals to experiment with sharing/contracting. As a result, they may permanently adopt such practices. Constraining this effect is that hospitals, particularly larger ones, may find that only moderate savings can be attained through sharing/contracting. It thus seems likely that the Indiana Program will increase shared/contracted services, but only to a modest degree.

In summary, the following hypothesis will be tested in this area.

(15) The Indiana Program will have a modest positive influence on shared/contracted services in 1973, a weaker positive or insignificant impact on such services in 1968, and a positive effect on the percentage change in such services between these years.

15.
Endogenous Variables

This chapter describes the development and characteristics of the endogenous variables analyzed in Segment II. The variables are discussed in the same order as the endogenous factors are considered in the preceding chapter, beginning with component costs and closing with shared/contracted services.

The data sources for the Segment II variables are the Project Survey and the Medicare Cost Reports, both of which are described in Chapter 7. The specific source is indicated for each variable. Means and standard deviations of the Segment II variables are shown in Appendix B. As in Chapter 11, important correlations among these variables are discussed in this chapter.

Component Costs

As is true for total and departmental costs, the numerator of each component cost is the respective cost figure and the denominator is hospital cases. Professional expenses and non-patient care costs are excluded from these variables, as from the other cost variables. The data source for component costs is the Medicare Cost Reports, as it is for the other cost measures.

The numerator of labor cost is salaries and wages paid by the hospital. The numerator of capital cost is dominated by depreciation and interest, but also includes such related expenses as real estate/property taxes, liability insurance, and amortization. The numerator of supply/service cost is comprised of all remaining hospital expenses, including employee fringe benefits. While such benefits are closely related to labor costs, it was often impossible to accurately identify fringe benefit costs in the Medicare Cost Reports. It was consequently not feasible to include fringe benefit expenses with salaries and wages in labor cost.

Similar to total and departmental costs, there were dramatic increases in the component costs during the study years, although the extent of such increases varies substantially. Labor cost rose by 53% between 1968 and 1973. In contrast, capital cost increased by 122% while the rise in supply/service cost was intermediate, 88%.

The degree of variation in labor and supply/service costs is similar. In 1973 the coefficient of variation for all study hospitals is .31 for labor cost and .30 for supply/service cost. The degree of variation

in capital cost is approximately twice as great, with the coefficient of variation for this variable equalling .62. Similarly, the percentage change in capital cost exhibits more variation than the percentage changes in the other two cost variables.

As shown in Table 15-1, labor cost is the largest component of total cost, accounting for approximately 60% of the latter. Capital cost is the smallest of the three component costs, equalling only 7% of total cost. Supply/service cost thus accounts for approximately one third of total cost. Reflecting its lower percentage increase during the study years, labor cost represents a larger fraction of total cost in 1968 than in 1973, while the converse is true for supply/service and capital costs.

The same conclusion emerges from a comparison of the dollar increases in total and component costs between 1968 and 1973 (i.e., not the percentage increases in such costs, but rather their absolute increases in terms of dollars). In dollar terms labor cost accounted for 52% of the increase in total cost, while supply/service and capital costs were responsible for 40% and 8% of the increase respectively. Hence, despite the greater percentage increase in capital cost during the study years, this cost still accounted for only a modest fraction of the dollar increase in total cost.

Table 15-1

COMPONENT COSTS AS A PERCENTAGE OF TOTAL COST

	Percentage of Total Cost		
Component Cost	1973	1968	$ Increase 1968-1973
Labor Cost	58.6%	63.0%	51.8%
Supply/Service Cost	34.1%	30.2%	40.2%
Capital Cost	7.3%	6.8%	8.0%

In 1973 both labor and supply/service costs are highly correlated with total cost, as indicated in Table 15-2. Capital cost is much less strongly correlated with total cost, but the association between total and capital costs is still markedly positive. Consistent with the total cost correlations, labor and supply/service costs have a strong positive association, with the correlations between capital cost and the other component costs being much lower, but still significantly positive. A similar correlation pattern characterizes the 1968 relationships among these four cost variables.

Table 15-2

CORRELATIONS AMONG 1973 COMPONENT AND TOTAL COSTS

Component Cost	Total Cost	Labor Cost	Supply/ Service Cost
Labor Cost	.96		
Supply/Service Cost	.90	.80	
Capital Cost	.40	.25	.23

As Table 15-3 indicates, the correlations among the percentage changes in these cost variables resemble the associations among the variables in 1973. The most significant difference between the correlation patterns is that the percentage change in capital cost is more strongly related to the percentage changes in the other cost variables than 1973 capital cost is to the other cost variables in that year.

Table 15-3

CORRELATIONS AMONG PERCENTAGE CHANGES IN COMPONENT AND TOTAL COSTS

Component Cost	Total Cost	Labor Cost	Supply/ Service Cost
Labor Cost	.88		
Supply/Service Cost	.83	.61	
Capital Cost	.65	.37	.45

Labor Usage

The data source for these variables is the Project Survey. As discussed in the preceding chapter, these variables are based solely on the three major nursing personnel categories -- registered nurse (RN), licensed practical nurse (LPN), and nurses' aide/orderly (NA). Although questions directed toward non-nursing categories were included on the Project Survey, hospitals responded to such questions less frequently than they did to the nursing personnel questions. Therefore, to assure comparability across hospitals only nursing data was used to construct the labor usage variables.

Despite the higher response rate to the nursing personnel questions, fewer study hospitals responded to such questions than to the non-labor usage questions on the Project Survey. Consequently, it was necessary to use a subsample of Segment II hospitals to conduct the labor usage analyses. This subsample consists of the 90 institutions which have complete data for the three labor usage variables.

The minimum or entry-level wage rate for each nursing category is used to construct the wage level index. As the basis for this index, this wage rate is superior to the maximum wage rate, since the latter is influenced not only by the hospital's prevailing wage rates, but also by the tenure and expertise of a few individuals employed by the hospital. The minimum wage rate is also superior to the wage rate at the end of a specified employment period since hospitals report the former more consistently than the latter.[1]

As shown below, the wage level index equals the average of the minimum wage rate for RNs, LPNs, and NAs.

$$WI_i = \frac{(W_{RN})_i + (W_{LPN})_i + (W_{NA})_i}{3} ,$$

where WI_i = Wage level index for the i^{th} hospital

$(W_{RN})_i$ = Minimum wage rate for RNs in the i^{th} hospital

$(W_{LPN})_i$ = Minimum wage rate for LPNs in the i^{th} hospital

$(W_{NA})_i$ = Minimum wage rate for NAs in the i^{th} hospital

As shown in Table 15-4, the wage level index is highly correlated with each of its components. The lowest such correlation, that involving the 1968 NA wage rate, is still high, .86. These findings support the validity of the wage level index by indicating that each component is synchronous with the index. This point is confirmed by supplementary regression analyses which indicate that each index component makes a significant contribution to the index, i.e., no component is redundant.

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[1] For confirmatory purposes maximum and beginning third-year wage rates for each personnel category were requested in the Project Survey. As expected, the correlations between each of these wage rates and the corresponding minimum wage rate are high. For example, the correlations between the minimum RN wage rate in 1973, and the maximum and beginning third-year RN wage rates for that year are .79 and .92 respectively.

Table 15-4

CORRELATIONS OF WAGE LEVEL INDEX WITH ITS COMPONENTS

	Wage Level Index	
Index Component	1973	1968
RN Minimum Wage	.95	.94
LPN Minimum Wage	.95	.94
NA Minimum Wage	.91	.86

Minimum wage rates for four non-nursing personnel categories were reported by a substantial number of study hospitals, albeit significantly fewer hospitals than those reporting nursing wage data. These four categories -- food service helper, typist, laundry worker, and x-ray technician -- span the major non-nursing areas of the hospital. The correlations between the wage level index and the minimum wage rates for these personnel categories are shown in Table 15-5. In each instance the correlation is highly positive. These results strongly support the contention made in the previous chapter that the wage rates of nursing personnel closely reflect prevailing wage rates across the hospital. It is thus likely that the wage level index, although drawn from only the three nursing categories, is an accurate indicator of wage levels throughout the hospital.

Table 15-5

CORRELATIONS BETWEEN WAGE LEVEL INDEX AND WAGE RATES OF NON-NURSING PERSONNEL CATEGORIES

	Wage Level Index	
Non-Nursing Minimum Wage Rates	1973	1968
Food Service Helper	.89	.82
Typist	.89	.85
Laundry Worker	.88	.78
X-Ray Technician	.68	.55

The skill mix index is directed toward the relative proportions of RNs, LPNs, and NAs employed by the hospital. That is, this index is of the following general type:

$$SM = m_1\left(\frac{RN}{N}\right) + m_2\left(\frac{LPN}{N}\right) + m_3\left(\frac{NA}{N}\right) ,$$

where SM = Skill mix index

RN = Number of RNs employed by hospital

LPN = Number of LPNs employed by hospital

NA = Number of NAs employed by hospital

N = Number of RNs, LPNs, and NAs employed by hospital

m_1, m_2, and m_3 = Set of weights reflecting the relative skills of RNs, LPNs, and NAs

Two operational problems are involved in the construction of this index. The first is how to measure the numbers of RNs, LPNs, and NAs. The best data for this purpose would be the precise number of full-time equivalents (FTEs) employed by the hospital during a given year. However, the Survey pretest indicated that most hospitals would not be able to provide such information. Therefore, the Survey requested the number of full-time and part-time RNs, LPNs, and NAs employed at the end of the 1968 and 1973 fiscal years. These figures were converted to estimated FTEs by assigning a weight of 1.0 to full-time employees and a weight of .5 to part-time staff members.

The second and more difficult problem in constructing this index was to develop the set of weights (m_1, m_2, and m_3). The most satisfactory basis for such weights would be detailed productivity estimates for the three nursing personnel types calculated across a range of tasks. However, such estimates are not available. It was therefore necessary to use the wage levels of the three personnel types as the basis for the weights. The rationale for this approach is that these wage levels reflect to a substantial extent the differing skills of the three personnel types.[2]

To implement this approach, the NA's wage level was taken as the base. Hence, m_3 became the ratio of the NA's wage level to the NA's wage level, or 1.00; m_2, the ratio of the LPN's wage level to the NA's wage level; and m_1 the ratio of the RN's wage level to the NA's wage level. To determine these weights, the wage rate of each personnel type was set at the average of the median minimum wage rates in 1968

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[2] Altman (1971) uses a similar approach to calculate an index showing the supply of nursing manpower in different regions.

and 1973.[3] Using this approach, m_1 equals 1.87; m_2 equals 1.35; and, as noted above, m_3 equals 1.00.

Thus, the precise formula for the skill mix index becomes:

$$SM_i = 1.87 \left(\frac{RN}{N}_i\right) + 1.35 \left(\frac{LPN}{N}_i\right) + 1.00 \left(\frac{NA}{N}_i\right) ,$$

where SM_i = Skill mix index for the i^{th} hospital

RN_i = Number of estimated RN FTEs employed by the i^{th} hospital

LPN_i = Number of estimated LPN FTEs employed by the i^{th} hospital

NA_i = Number of estimated NA FTEs employed by the i^{th} hospital

N_i = Number of estimated RN, LPN, and NA FTEs employed by the i^{th} hospital

As indicated in Table 15-6, the correlations between the skill mix index and its components follow the expected pattern. That is, the correlation between the index and the RN fraction is strongly positive in both study years; that between the index and the NA fraction is highly negative; and that between the index and the LPN fraction is modestly positive.

Table 15-6

CORRELATIONS OF SKILL MIX INDEX WITH ITS COMPONENTS

	Skill Mix Index	
Index Component	1973	1968
$\frac{RN}{N}$	.93	.90
$\frac{LPN}{N}$	.24	.13
$\frac{NA}{N}$	-.91	-.86

[3] The median was used to construct these weights in order to minimize the influence of outliers. However, the results are approximately the same if the mean is used instead of the median.

The unionization index is a scaled measure incorporating four general principles. First, a personnel category should be considered unionized only if at least 50% of the employees in that category belong to a union (or professional association representing employees in collective bargaining sessions with hospital management). If this criterion is not satisfied, the union's leverage will be weak since the hospital can easily shift from union to nonunion employees. Second, unionization of the first nursing personnel category will have a greater impact than unionization of subsequent categories, although the effects of the latter will be appreciable.

Third, significant but unsuccessful union activity directed toward one or more of the nursing categories may appreciably affect the wage levels of nursing personnel, provided that such activity occurred in the recent past. By the same token, unionization of non-nursing personnel categories can significantly influence nursing wage levels.[4] Fourth, unionization in a study year will have less impact than unionization which occurred prior to a study year. The logic underlying this thesis is that Survey data does not permit identification of the month in which unionization occurred.

Based upon these principles, the unionization index was constructed in the following way. A base of 1.0 was established to indicate no significant union activity. Points were added to that base for different types of union activity, as specified in Table 15-7. As noted previously, unionization is defined as unionization of at least 50% of the personnel in the given category.[5]

It is useful to consider several examples to illustrate the construction of this index. First, a hospital with no significant union activity has a value of 1.0 on this index, while a hospital with unionization of all three nursing categories prior to the study year has a value of 7.0.[6] Hospitals of these types represent the polar points on this index, which thus ranges from 1.0 to 7.0. Second, a

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[4] Unionization data was more frequently provided by hospitals than was data for the other labor usage measures. It was consequently possible for this index to take into account unionization of non-nursing personnel categories.

[5] This 50% rule is not only substantively sound, but it also proved operationally satisfactory since in no study hospital did unionization of a personnel category approach 50% but fall short of that mark.

[6] In this example, to the base of 1.0 is added 4.0 for type D activity, 1.0 for type F activity, and 1.0 for type H activity to arrive at the value of 7.0.

hospital whose food service helpers and laundry workers were unionized in 1968 and whose NAs were unionized in 1970 has a value on this index of 1.5 in 1968 and 5.0 in 1973. Third, a hospital whose RNs and LPNs were unionized in 1968 has a value on the index of 3.5 in 1968 and 6.0 in 1973.

Table 15-7

COMPOSITION OF UNIONIZATION INDEX

Type of Union Activity	Description of Activity	Points Added To The Base of 1.0
A	Given that there are no other types of union activity, significant but unsuccessful union activity directed toward a nursing category(ies) and/or unionization of a non-nursing category(ies) occurring during the study year.	.5
B	Given that Types C - H of union activity do not exist, significant but unsuccessful union activity directed toward a nursing category(ies) occurring during the five years prior to the study year and/or unionization of a non-nursing category(ies) beginning prior to the study year.	1.0
C	Given that no nursing categories were unionized prior to the study year, unionization of one category during the study year.	2.0
D	Unionization of one nursing category prior to the study year.	4.0
E	Given that one nursing category was unionized either during the study year or prior to that year, unionization of a second nursing category during the study year.	.5
F	Given that one nursing category was unionized before the study year, unionization of a second nursing category prior to that year.	1.0
G	Given that two nursing categories were unionized either during the study year or prior to that year, unionization of the remaining nursing category during the study year.	.5
H	Given that two nursing categories were unionized before the study year, unionization of the remaining nursing category prior to the study year.	1.0

In 1973 the mean of the wage level index for all study hospitals is $2.96 (i.e., $2.96 per hour, since nursing wage rates are measured in dollars per hour). The mean of the skill mix index is 1.40. This result occurs because study hospitals use approximately the same number of RNs and NAs and about half as many LPNs as either of the other personnel types. That is, the RN and NA fractions average .40 each and the LPN fraction .20. The mean of the unionization index is low, 1.90, because most study hospitals were not directly affected by union activity during the study years. As expected, the degree of variation is much greater for the unionization index than for the other two labor usage measures. The coefficient of variation for the former is 1.03, while those for the wage level and skill mix indices are .12 and .06 respectively.

Consistent with the inflationary trend during the study years, the mean percentage increase in the wage level index is 33%. The average percentage rise in the unionization index is also 33%. However, the skill mix index changed very little during the study period; its average percentage increase is only 2%.

The correlation between wage level and skill mix is insignificant in both 1968 and 1973. Similarly, the percentage changes in these two variables are not significantly related. These findings support the thesis that there is no substantive reason to expect wage level to be higher in those hospitals using a higher skill mix, or vice versa.

Since the impact of unionization on wage level is investigated through the regression analyses described in Chapter 16, the correlation results for these two variables are not reported here. As expected, the correlation between skill mix and unionization is insignificant, as is the correlation between the percentage changes in these two indices.

Capital Usage

Capital expenditures is defined as capital outlays for substantial projects completed between 1968 and 1973. A substantial project is one which produces any of the following three results:

- a change in the number of hospital beds;
- an increase in the range of services offered; or
- a capital expenditure equal to at least $100,000.

This study thus defines capital expenditures in approximately the same way as do the Indiana Program, Public Law 92-603, and most state certificate of need laws.

The primary data source for the capital expenditures variable is the Project Survey. Survey data was cross-checked with the MCR data.[7] If there was a significant divergence between the two sources, both were analyzed in detail in order to determine the most accurate estimate of capital expenditures.

The other Segment II capital usage variable is the percentage change in bed size between 1968 and 1973. Bed size is defined as described in Chapter 9, i.e., as the number of bed days available for a given year divided by 365 days.

The average percentage change in bed size is 14% for Segment II hospitals, which is precisely the same as the mean of this variable in the Segment I analyses. The mean for capital expenditures (in 1,000s) is $2,670. That is, capital outlays during the study period averaged slightly over $2.5 million for the project hospitals. The degree of variation in these two indices is approximately the same. The coefficient of variation equals 1.68 for the percentage change in bed size and 1.50 for capital expenditures.

The correlation between capital expenditures and the percentage change in bed size is .26. While this correlation is statistically significant at the .01 level, it is nonetheless modest. The degree of common variation between these variables is only 7%. This finding indicates that these two capital usage factors are not proxies for each other and cannot be used interchangeably.

The percentage change in capital intensity is positively related to both Segment II capital usage variables. The correlation is higher for capital expenditures, .30, than for the percentage change in bed size, .17. However, as expected, in neither instance is this correlation strongly positive. The correlations between the two Segment II capital usage variables and the percentage change in capital cost are also significantly positive, but relatively modest: .32 for capital expenditures and .25 for the percentage change in bed size.

Financial Position

The data source for the financial position variables is the Medicare Cost Reports. Balance sheet and related information from which these variables are drawn is less consistently presented in the MCRs than is basic operating data, such as costs or cases. Further, in some instances such financial data was entirely missing from a Medicare

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[7] Capital expenditures are not directly shown on the Medicare Cost Reports, but they can often be estimated from detailed information provided on the hospital's balance sheet and related financial reports.

Cost Report. Because of both factors it was necessary to use a smaller sample for the financial position analyses than for the main Segment II analyses. This sample consists of the 125 Segment II hospitals which have complete financial position data.

Net worth and working capital are defined similarly. The former index equals total assets minus total liabilities divided by bed size; the latter index equals current assets minus current liabilities divided by bed size. In each index, bed size (a semi-exogenous variable throughout this study) is used as a deflator because of its strong positive association with the variable's numerator. Both indices thus indicate the hospital's financial position in terms of its basic plant size.

In these indices current assets are defined as assets readily marketable at any point in time and/or expected to turn over by the end of the subsequent fiscal year. Current assets thus include cash, accounts receivable, inventories, and easily marketable investments. Current liabilities are defined as those liabilities for which payment is due within a year. Current liabilities encompass accounts payable, accrued salaries, payroll taxes, and short-term loans.

Total liabilities include current liabilities and long-term debts, such as mortgages and long-term loans. In addition to current assets, total assets encompass long-term assets, including the net value of plant and equipment. Net worth thus suffers from the same problems as capital intensity whose numerator is the net value of plant and equipment. That is, depreciation practices may vary substantially across hospitals, and depreciation schedules acceptable in the accounting world may not accurately reflect the economic value of plant and equipment. Even so, as emphasized in the preceding chapter, net worth is the most accurate indicator of financial position since it specifies the net financial value of the hospital at a given point in time.

At times the total and current ratios (i.e., total assets divided by total liabilities and current assets divided by current liabilities) have been used to assess hospital financial position. For two reasons these variables are not as satisfactory for this purpose as the net worth and working capital indices employed in this study. First, they are substantively less on-point since, for example, the crucial issue is the degree to which total assets exceed total liabilities, rather than the ratio between these statistics.

Second, and more important, the total ratio and especially the current ratio are subject to sharp fluctuations produced by factors having no influence on the real financial position of the institution. An example illustrates this point. Suppose that in one year a hospital has $400,000 in current assets and $200,000 in current liabilities, and that in another year it has $250,000 in current assets and $50,000 in current liabilities. In each instance the hospital's current financial position is the same. That is, its current assets exceed

its current liabilities by $200,000. However, this hospital's financial position as indicated by the current ratio is drastically different since the ratio equals 2.0 in the first instance and 5.0 in the second.

The remaining financial position variable, profit margin, is defined as the difference between total patient care revenue and total patient care cost divided by total patient care revenue. If revenue exceeds cost, this variable is positive; if cost is higher than revenue, the converse is true.

Non-patient care costs and revenues are excluded from this variable for two reasons. First, the Indiana Program does not attempt to control non-patient care activities. Second, non-patient care costs and especially non-patient care revenues can have sharp effects on profit margin which often vary in an idiosyncratic manner from year to year. For example, a hospital may earn a healthy return on a stock or real estate investment in one year and experience losses on similar investments in another year. In either instance the hospital's investment return is independent of its patient care activities.

The mean for 1973 net worth for all study hospitals is $27,556. The net value of hospital assets per bed thus averaged slightly over $25,000 in the last main study year. Net worth increased substantially during the study period with the average percentage increase in this variable being 42%. The mean percentage increase in working capital was even higher, 60%. The mean value for working capital in 1973 was $7,778. Thus, net worth was approximately three and one half times as great as working capital in that year. As expected, the degree of variation in working capital is higher than that in net worth. In 1973 the coefficient of variation equalled .59 for working capital and .38 for net worth.

In 1973 the mean of profit margin is -.03. Since the mean for this variable in 1968 is close to zero, its mean percentage change across the study period equals almost -100%. However, the implications of this finding are modest since they are primarily due to profit margin's low value in 1968.

In 1973 the coefficient of variation for profit margin is 2.15, which is far higher than the corresponding statistic for the other two financial position variables. This result must also be interpreted with care because profit margin, unlike the other two variables, exhibits substantial numbers of positive and negative values across the study hospitals. The coexistence of such values drives the mean of the variable toward zero, but does not affect the standard deviation, thereby increasing the coefficient of variation.

The association between net worth and working capital is distinctly positive, although not overwhelmingly so. In 1973 the correlation between these two variables is .36; in 1968 it is .48; and the correlation between the percentage changes in these measures is .40.

Hence, even in 1968, the year in which the two variables are most closely associated, the degree of common variation is only 23%. These findings support the expectation that these two indices are related yet different indicators of hospital financial position.

In contrast, profit margin is not significantly associated with either net worth or working capital. This result holds in 1973, 1968, and for the percentage changes in the variables. These findings have two implications. First, they indicate that profit margin is largely independent of the other two variables. Second, given that net worth and working capital are valid indicators of hospital financial position, they suggest that profit margin may be a relatively inaccurate indicator of hospital financial status. This implication is not sufficiently strong to require the deletion of profit margin from the analyses, but it is sufficient to warrant caution in generalizing the profit margin results to overall hospital financial position.

Shared/Contracted Services

The data source for this variable is the Project Survey. As discussed in Chapter 14, this index is based upon hospitals' sharing or contracting for three nonmedical services -- laundry, dietary, and purchasing. If a hospital did not share or contract for a service during a study year, it received a value of 1.0 for that service for that year; if a hospital began sharing or contracting for a particular service during the study year, it was given a value of 2.0 for that service for that year; and if a hospital initiated sharing or contracting for a service prior to the study year and continued with that practice during the study year, it received a value of 3.0 for that service for that year. The rationale for assigning less weight to sharing/contracting implemented during a study year is analogous to that for the unionization index -- the Survey data does not indicate the month in which the sharing/contracting began.

In this index sharing of laundry or dietary services is defined as sharing the respective service with one or more hospitals; contracting for these services is specified as contracting for the respective service with an outside firm specializing in such service; and shared/contracted purchasing is defined as the existence of a joint purchasing agreement with one or more hospitals, regardless of whether an outside firm assists the purchasing network.

The hospital's values for sharing/contracting of the three services were summed to produce the shared/contracted services index. The index thus ranges from 3.0 to 9.0. For example, if a hospital does not share or contract for any of the services, it has a value of 3.0 on this index (i.e., 1.0 for each service). Correspondingly, if a hospital began sharing/contracting for all three services prior to the study year, its value for this index is 9.0 (i.e., 3.0 for each service). As

another example, if a hospital entered a joint purchasing agreement in 1966 and began contracting for laundry services in 1968, but did not share or contract for dietary services through 1973, its values for this index are 6.0 in 1968 and 7.0 in 1973.

Table 15-8 shows the correlations between this index and its three components. Each correlation is high indicating that each component is consonant with the index. However, no correlation is so strong as to suggest that one component dominates the index. In fact, the correlations are similar, indicating that each component makes approximately the same contribution to the index (a point corroborated by regression analysis).

Table 15-8

CORRELATIONS OF SHARED/CONTRACTED SERVICES INDEX WITH ITS COMPONENTS

	Shared/Contracted Services Index	
Index Component	1973	1968
Shared/Contracted Laundry	.67	.69
Shared/Contracted Dietary	.63	.62
Joint Purchasing	.62	.57

The mean of this index is 4.3 in 1973, which indicates that the prevalence of sharing/contracting for these three services by study hospitals is relatively low. Its degree of variation is substantial, but not high. In 1973 the coefficient of variation for this index is .36.

16.
Effects on Labor and Capital Usage

While the theme of this chapter is labor usage and capital usage, its initial subject is the influence of the Indiana Program on the component costs. These include supply/service cost as well as labor and capital costs. The labor usage analyses are the next chapter topic, followed by a discussion of the capital usage results.

This chapter utilizes the same format as that in Chapters 12 and 13. The overall results of each set of analyses are discussed prior to the detailed findings. Review of the former concentrates on the percentage impact statistic while discussion of the latter covers a series of topics, including the predictive power and collinearity of the final equations. As discussed earlier, the percentage impact statistic indicates the Indiana Program's influence on endogenous variables. As an approximation, it specifies the percentage difference in the endogenous variable that would be expected if the control hospitals had been operating under the Indiana Program.

Component Costs

Overall Results

Findings -- It was hypothesized in Chapter 14 that the Indiana Program would have a negative impact on labor cost in both 1973 and 1968, but that this impact would be greater in the later year. Correspondingly, it was anticipated that the Program would have a negative influence on the percentage change in labor cost.

These expectations are largely supported by the findings. This is especially true in the Combined comparisons, as shown in Table 16-1. In these analyses the percentage impact of the Indiana Program is -6% in 1968 and -12% in 1973, with the Program's effect on the percentage change in labor cost being -18%.

In both the Michigan and Tristate analyses there are modest deviations from the Chapter 14 hypotheses. In the Tristate comparisons the percentage impact of the Indiana Program is approximately the same in 1973 and 1968: -9% and -8% respectively. Because labor cost increased substantially during the study period, the Program still exerts a -13% influence on the percentage change in such costs. While the Program's influence on labor cost in the 1973 Michigan analyses is -12%, its effect on such cost in 1968 is insignificant. Correspondingly, the Program's impact on the percentage change in labor cost is greatest in the Michigan analyses, -23%.

Table 16-1

IMPACT OF THE INDIANA PROGRAM ON LABOR COST

	COMBINED	MICHIGAN	TRISTATE
1973	-12%	-12%	-9%
1968	-6%	0*	-8%
% Δ	-18%	-23%	-13%

*If the impact of the Indiana Program is not significant at least at the .05 level, it is reported as a zero in this and similar tables in Section V.

It was hypothesized that the Indiana Program would have a negative impact on supply/service cost in 1973, but only a weakly negative or insignificant impact on such cost in 1968. It was thus anticipated that the Program would have a negative influence on the percentage change in supply/service cost. It was also expected that the Program's effect on supply/service cost would not be as great as its influence on labor cost.

The results substantiate these hypotheses. As shown in Table 16-2, in the Combined analyses the Program's impact on supply/service cost is insignificant in 1968 and -14% in 1973. Accordingly, its influence on the percentage change in this variable is negative, -15%. In the Michigan and Tristate analyses the Program's effect is also insignificant in 1968. In 1973 its Michigan effect is greater than its Tristate influence, but both are significantly negative, -18% and -7% respectively. Similarly, the Program's impact is -21% and -11% respectively in the Michigan and Tristate percentage change analyses.

Table 16-2

IMPACT OF INDIANA PROGRAM ON
SUPPLY/SERVICE COST

	COMBINED	MICHIGAN	TRISTATE
1973	-14%	-18%	-7%
1968	0	0	0
% Δ	-15%	-21%	-11%

In the Combined analyses the Program's labor cost effect is greater than its supply/service cost impact in 1968: -6% versus insignificance. In 1973 its percentage impact on supply/service cost is greater than its percentage influence on labor cost: -14% compared to -12%. However, because of the larger magnitude of labor cost, its dollar impact in 1973 is stronger on labor cost than on supply/service cost, -$53 and -$35 respectively.

The 1973 findings are reversed in the percentage change results. The Program's percentage impact is stronger on the percentage change in labor cost than on the percentage change in supply/service cost: -18% versus -15%. However, because supply/service cost rises more rapidly than labor cost during the study years, the Program reduces the percentage change in supply/service cost by an absolute amount of -14%, while it lowers the percentage change in labor cost by an absolute amount of -10%.

It was expected that the Indiana Program would have a negative impact on capital cost in 1973, but only a modestly negative or insignificant influence on such cost in 1968. It was further hypothesized that the Program would have a negative effect on the percentage change in such cost. However, it was anticipated that its impact on capital cost would be the least strong of the Program's effects on component costs.

Unlike the other two analyses, the findings in this instance do not support these hypotheses. As shown in Table 16-3, in 1973 the Program has an insignificant influence on capital cost in all three analyses. Further, in the Tristate analyses it also has insignificant effects on 1968 capital cost and the percentage change in capital cost. In contrast, in the 1968 Michigan comparison the Program has a positive impact on capital cost, +53%. Although this influence is large in percentage terms, it is modest in dollar terms -- $12 -- because of the small size of capital cost compared to the other component costs. Correspondingly, the Program has a smaller, but still significant, impact on capital cost in the 1968 Combined analysis, +25%. Its dollar impact in this instance is $7.

Table 16-3

IMPACT OF INDIANA PROGRAM ON CAPITAL COST

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1968	+25%	+53%	0
% Δ	0	0	0

In spite of the 1968 and 1973 findings in the Michigan and Combined analyses, the Program does not have a significant effect on the percentage change in capital cost in these comparisons. This finding is analogous to Segment I departmental cost results and presumably occurs for the same reason -- the higher idiosyncratic variation in the percentage change analyses. Accordingly, the annual results are given precedence in the interpretation of the capital cost analyses.

Interpretation -- These analyses definitively establish that the Indiana Program has a strong negative influence on labor cost. Although its effect on this component cost is significant in 1968, its influence is distinctly greater in 1973. Consonant with this finding, the Indiana system exerts a substantial negative influence on the percentage change in labor cost.

An equally important finding is that the Indiana Program exerts a negative influence on supply/service cost, an area of hospital operations not directly examined in Segment I. Unlike its effect on labor cost, the Program's impact on supply/service cost does not become significant until 1973. Accordingly, the Program exerts a strong negative influence on the percentage change in this cost.

The labor and supply/service cost findings were largely expected. In distinct contrast, the capital cost results were not. In no instance does the Indiana Program exert a negative influence on capital cost. Compared to the Tristate Type I environment, the Program has an insignificant effect on capital cost in all study time periods. Compared to the Michigan Type II environment, the Program has an insignificant effect on capital cost in 1973 and a positive impact in 1968. It is uncertain to what extent the latter result is attributable to the Indiana Program or the Michigan program. At a minimum it is clear that the Indiana Program is not more effective than the Michigan program in controlling capital costs in either 1968 or 1973.

The Program's effects on the component costs in the Combined analyses are summarized in Table 16-4 and 16-5. In 1968 labor cost is the only component cost which is negatively influenced by the Indiana Program. The Program's effect on capital cost is positive, but much smaller in dollar terms than its negative impact on labor cost. Its influence on supply/service cost is insignificant.

In 1973 the Program exerts a negative influence on both labor cost and supply/service cost. In fact, in percentage terms its impact on the latter is stronger than its influence on the former. However, in dollar terms its impact on labor cost is substantially greater than its influence on supply/service cost. Its effect on capital cost is insignificant in this year.

Table 16-4

INFLUENCE ON COMPONENT COSTS IN 1968

	Percentage Impact	Dollar Impact
Labor Cost	-6%	-$18
Supply/Service Cost	0	0
Capital Cost	+25%	+$7

The Program's rising influence on total cost between 1968 and 1973 is produced almost equally by its accelerating effects on labor cost and supply/service cost. Its impact on capital cost also contributes to some extent to its increasing influence on total cost because it shifts from positive in 1968 to insignificant in 1973.

Table 16-5

IMPACT ON COMPONENT COSTS IN 1973

	Percentage Impact	Dollar Impact
Labor Cost	-12%	-$53
Supply/Service Cost	-14%	-$35
Capital Cost	0	0

Labor cost is thus the primary pathway through which the Indiana Program reduces total cost. Supply/service cost is also an important vehicle transmitting the Program's cost influence, but not until the latter part of the study period. In contrast, the Program does not reduce total cost by decreasing capital cost in either 1973 or 1968.

Detailed Findings

The predictive power of the labor cost annual analyses is high, as shown in Table 16-6. The R^2s in these equations range from .67 in the 1968 Combined analysis to .81 in the 1973 Michigan comparison. Collinearity involving the Indiana Program is low. The Program's highest covariance ratio is .27 in the 1973 Michigan equation. Overall collinearity is higher in these equations, but is still relatively modest. The lowest value for the determinant is .10 in the 1973 Michigan equation; in the other equations the determinant is .20 or higher.

Table 16-6

ANNUAL ANALYSES OF LABOR COST

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-53×10^{0}	-18×10^{0}	-55×10^{0}	-13×10^{0}	-37×10^{0}	-20×10^{0}
t-value	-4.55	-2.32	-3.42	-1.16	-3.18	-2.48
% impact	-12.1	-6.4	-11.8	-4.6	-9.2	-7.5
covariance	0.11	0.08	0.27	0.26	0.14	0.14
Length of Stay						
coefficient	35×10^{0}	26×10^{0}	34×10^{0}	30×10^{0}	25×10^{0}	22×10^{0}
t-value	6.18	7.96	4.45	7.00	4.36	6.16
ECF						
coefficient	70×10^{1}	39×10^{1}	59×10^{1}	68×10^{1}	65×10^{1}	40×10^{1}
t-value	6.50	5.56	3.56	3.25	5.86	6.03
Emergency/Outpatient						
coefficient	54×10^{1}	57×10^{1}	65×10^{1}	44×10^{1}		65×10^{1}
t-value	3.35	4.00	2.92	2.22		3.76
Medical Education						
coefficient	13×10^{2}	94×10^{1}	12×10^{2}	89×10^{1}	27×10^{2}	17×10^{2}
t-value	6.21	4.49	4.96	3.54	7.78	4.36
Fiscal Year						
coefficient	49×10^{-1}	38×10^{-1}	83×10^{-1}	54×10^{-1}		31×10^{-1}
t-value	2.69	3.06	3.20	2.88		2.30
Nonprofit Control						
coefficient	-24×10^{0}		-29×10^{0}		-24×10^{0}	
t-value	-1.99		-1.85		-1.81	
MD Concentration						
coefficient	50×10^{-2}		51×10^{-2}			
t-value	2.65		2.08			
Income						
coefficient	18×10^{-3}	15×10^{-3}	14×10^{-3}	16×10^{-3}	19×10^{-3}	14×10^{-3}
t-value	3.26	4.13	1.67	2.94	3.59	3.67
White						
coefficient	-52×10^{1}	-15×10^{1}	-63×10^{1}	-15×10^{1}	-66×10^{1}	-26×10^{1}
t-value	-5.25	-2.44	-5.21	-2.03	-5.10	-3.11
R^2	0.77	0.67	0.81	0.71	0.75	0.69
Determinant	0.20	0.45	0.10	0.29	0.33	0.45
Constant	37×10^{1}	-49×10^{-1}	48×10^{1}	-53×10^{0}	66×10^{1}	14×10^{1}

As indicated by its t-value, the influence of the Indiana Program on labor cost is significant at the .001 level in all the 1973 analyses. It is significant at the .01 level in the 1968 Tristate equation and at almost that level in the 1968 Combined equation. Its effect is negative but insignificant in the 1968 Michigan equation.

As in the Segment I total cost analyses, length of stay, ECF involvement, emergency/outpatient involvement, medical education involvement, fiscal year and income level exert a positive impact on labor cost. Similarly, white population has a negative influence on this cost. Analogous to the earlier total cost equations, physician concentration has a positive impact on labor cost, but only in the 1973 Combined and Michigan comparisons. One other variable, nonprofit control, significantly influences labor cost in 1973; its impact is negative. This variable does not significantly affect total cost, but it does exert a negative influence on nursing cost, the most labor-intensive of the departmental costs.

The predictive power of the labor cost percentage change analyses is substantial, but not as high as that of the annual analyses. As displayed in Table 16-7, the R^2 is highest in the Michigan equation, .67, and lowest in the Tristate equation, .48. Collinearity is even lower in these analyses than in the annual labor cost analyses. The covariance ratio of the Indiana Program ranges from .06 to .17, and the determinant from .42 to .87. Reflecting the percentage impact findings, the effect of the Indiana Program is significant at the .001 level in the Michigan equation, at the .01 level in the Combined analysis, and at the .05 level in the Tristate comparison.

Analogous to the annual analyses, the percentage changes in length of stay, ECF involvement, emergency/outpatient involvement, and medical education involvement exert a positive impact on the percentage change in labor cost. White population has a negative impact on the percentage change in labor cost, which is consistent with its greater negative influence on labor cost in 1973 than in 1968. Farm population has a positive effect on labor cost, but only in the Michigan equation.

Table 16-7

PERCENTAGE CHANGE ANALYSES OF LABOR COST

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-10×10^{-2}	-15×10^{-2}	-70×10^{-3}
t-value	-2.99	-3.47	-1.92
% impact	-17.9	-23.0	-13.4
covariance	0.06	0.17	0.09
% Δ Length of Stay			
coefficient	16×10^{-1}	18×10^{-1}	15×10^{-1}
t-value	9.64	9.29	7.93
% Δ ECF			
coefficient	37×10^{-2}	41×10^{-2}	28×10^{-2}
t-value	7.52	6.21	5.27
% Δ Emergency/Outpatient			
coefficient	81×10^{-3}	12×10^{-2}	70×10^{-3}
t-value	2.44	3.19	2.02
% Δ Medical Education			
coefficient	30×10^{-3}	32×10^{-3}	39×10^{-3}
t-value	1.87	1.94	2.46
White			
coefficient	-55×10^{-2}	-11×10^{-1}	
t-value	-2.15	-3.27	
Farm			
coefficient		81×10^{-2}	
t-value		2.54	
R^2	0.58	0.67	0.48
Determinant	0.77	0.42	0.87
Constant	12×10^{-1}	16×10^{-1}	61×10^{-2}

The predictive power of the supply/service cost annual analyses is solid, although lower than that of the annual labor cost analyses. As indicated in Table 16-8, the R^2s in these equations range from .63 in the 1968 Michigan comparison to .48 in the 1968 Tristate analysis. Collinearity is low in these equations. The covariance ratio of the Indiana Program is never higher than .22 and the determinant is never lower than .33.

In the 1973 Combined and Michigan equations the effect of the Indiana Program is significant at the .001 level. In partial contrast, the Program's influence is significant at only the .05 level in the 1973 Tristate equation. In all the 1968 equations its impact is clearly insignificant.

Table 16-8

ANNUAL ANALYSES OF SUPPLY/SERVICE COST

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-35×10^{0}	-45×10^{-2}	-51×10^{0}	48×10^{-1}	-17×10^{0}	-16×10^{-1}
t-value	-3.89	-0.09	-4.21	0.78	-1.98	-0.27
% impact	-13.6	-0.3	-18.1	3.7	-7.3	-1.3
covariance	0.08	0.07	0.15	0.22	0.14	0.14
Length of Stay						
coefficient	24×10^{0}	13×10^{0}	26×10^{0}	16×10^{0}	21×10^{0}	13×10^{0}
t-value	5.57	6.50	4.66	6.60	4.88	4.97
ECF						
coefficient	16×10^{1}	18×10^{1}		50×10^{1}	20×10^{1}	19×10^{1}
t-value	1.96	4.21		4.25	2.38	3.96
Emergency/Outpatient						
coefficient	45×10^{1}	31×10^{1}	50×10^{1}	31×10^{1}		33×10^{1}
t-value	3.69	3.58	2.90	2.83		2.70
Medical Education						
coefficient	52×10^{1}		47×10^{1}		84×10^{1}	53×10^{1}
t-value	3.36		2.66		3.32	1.99
Fiscal Year						
coefficient		32×10^{-1}		41×10^{-1}		40×10^{-1}
t-value		4.27		4.00		4.04
Nonprofit Control						
coefficient	-25×10^{0}				-21×10^{0}	
t-value	-2.39				-2.17	
MD Concentration						
coefficient	55×10^{-2}	27×10^{-2}	47×10^{-2}	33×10^{-2}		
t-value	3.75	2.96	2.51	3.10		
Income						
coefficient		71×10^{-4}		85×10^{-4}	89×10^{-4}	69×10^{-4}
t-value		3.67		3.31	2.30	2.74
White						
coefficient	-16×10^{1}				-36×10^{1}	
t-value	-2.26				-3.82	
R^2	0.56	0.51	0.59	0.63	0.56	0.48
Determinant	0.38	0.66	0.60	0.53	0.33	0.59
Constant	16×10^{1}	-11×10^{1}	-82×10^{-1}	-16×10^{1}	35×10^{1}	-90×10^{0}

Length of stay, ECF involvement, emergency/outpatient involvement, medical education involvement, fiscal year, and income level have positive effects on supply/service cost, as they do on labor cost. However, the influence of the latter three variables is not as consistent on supply/service cost as on labor cost. The same is true for white population, which exerts a negative influence on supply/service

cost only in the 1973 Combined and Tristate equations. In contrast, physician concentration has a stronger impact on this component cost than on labor cost. Similar to its impact on labor cost, nonprofit control exerts a negative influence on this component cost in the 1973 Combined and Tristate analyses but not in the Michigan comparison.

As shown in Table 16-9, the predictive power of the supply/service cost percentage change analyses is lower than that of the labor cost percentage change analyses, but it is still substantial. The R^2 ranges narrowly from .41 to .47. Collinearity is extremely low. The covariance ratio of the Indiana Program ranges from .02 to .09 and the determinant from .62 to .97. The effect of the Indiana Program is significant at the .01 level in the Michigan and Combined equations and at the .05 level in the Tristate comparison.

Table 16-9

PERCENTAGE CHANGE ANALYSES OF SUPPLY/SERVICE COST

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-14×10^{-2}	-22×10^{-2}	-91×10^{-3}
t-value	-2.62	-3.02	-1.72
% impact	-15.4	-20.7	-10.8
covariance	0.03	0.02	0.09
% Δ Length of Stay			
coefficient	19×10^{-1}	20×10^{-1}	19×10^{-1}
t-value	7.06	6.01	6.45
% Δ ECF			
coefficient	37×10^{-2}	45×10^{-2}	28×10^{-2}
t-value	4.65	3.87	3.62
Elderly Caseload			
coefficient	-55×10^{-2}		
t-value	-1.85		
Fiscal Year			
coefficient			-18×10^{-3}
t-value			-2.03
Nonprofit Control			
coefficient	-14×10^{-2}		-18×10^{-2}
t-value	-2.44		-3.09
White			
coefficient			-18×10^{-1}
t-value			-3.12
R^2	0.41	0.41	0.47
Determinant	0.78	0.97	0.62
Constant	14×10^{-1}	12×10^{-1}	30×10^{-1}

The percentage changes in length of stay and ECF involvement are strong positive determinants of this component cost variable. Nonprofit control exerts a negative influence in the Tristate and Combined equations, which is consistent with its effects in the annual analyses. White population and fiscal year also have negative effects in the Tristate comparison. In addition, elderly caseload exerts a negative influence in the Combined equation.

The predictive power of the capital cost annual analyses is much lower than that of the annual analyses of the other component costs. As shown in Table 16-10, the R^2 ranges from .33 in the 1968 Michigan equation to .10 in the 1973 Tristate comparison. An important factor partially responsible for this result is that capital cost, like capital intensity, is influenced both by variation in accounting practices across hospitals and by the fact that accounting value frequently does not coincide with market value. Another factor contributing to the lower R^2s is that the Program's influence is generally insignificant in these analyses.

Table 16-10

ANNUAL ANALYSES OF CAPITAL COST

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	35×10^{-2}	68×10^{-1}	43×10^{-1}	12×10^{0}	-16×10^{-1}	46×10^{-1}
t-value	0.07	2.27	0.58	3.03	-0.27	1.23
% impact	0.7	24.9	8.4	53.0	-3.1	16.2
covariance	0.05	0.09	0.20	0.17	0.04	0.11
Length of Stay						
coefficient	11×10^{0}		14×10^{0}	29×10^{-1}	85×10^{-1}	
t-value	4.49		4.27	1.84	2.92	
ECF						
coefficient	83×10^{0}	80×10^{0}	13×10^{1}	32×10^{1}		72×10^{0}
t-value	1.70	3.06	1.74	4.14		2.38
Elderly Caseload						
coefficient	-13×10^{1}		-15×10^{1}		-89×10^{0}	
t-value	-3.23		-3.15		-1.72	
Fiscal Year						
coefficient		91×10^{-2}		13×10^{-1}		12×10^{-1}
t-value		1.94		1.90		1.84
Nonprofit Control						
coefficient		80×10^{-1}		81×10^{-1}		77×10^{-1}
t-value		2.69		2.12		1.93
Income						
coefficient		41×10^{-4}		42×10^{-4}		46×10^{-4}
t-value		3.51		2.77		2.78
Farm						
coefficient	15×10^{1}		17×10^{1}		11×10^{1}	
t-value	3.47		2.75		2.22	
R^2	0.16	0.19	0.21	0.33	0.10	0.19
Determinant	0.38	0.80	0.34	0.67	0.38	0.72
Constant	63×10^{-1}	-25×10^{0}	-17×10^{0}	-59×10^{0}	15×10^{0}	-30×10^{0}

Collinearity in these equations is low, as it is in the other component cost analyses. The determinant ranges from .80 to .34, and the covariance ratio of the Indiana Program never exceeds .20. In the 1968 Michigan equation the positive effect of the Indiana Program is significant at the .01 level; in the 1968 Combined equation it is significant at the .05 level; and in the 1968 Tristate comparison the influence of the Indiana Program is also positive and almost significant at the .10 level. In all the 1973 equations the effect of the Indiana Program is highly insignificant.

Length of stay and ECF involvement have a positive impact on this component cost, as they do on the other component costs. Fiscal year, nonprofit control, and income level all exert positive effects on capital cost, but only in 1968. Elderly caseload has a negative impact on capital cost and farm population has a positive influence, but the effects of these variables are confined to 1973.

The predictive power of the capital cost percentage change analyses is similar in all three equations. As shown in Table 16-11, it approximates .25. Collinearity is very low. The covariance ratio of the Indiana Program ranges from .02 to .12, and the determinant ranges from .90 to .76.

Table 16-11

PERCENTAGE CHANGE ANALYSES OF CAPITAL COST

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-24×10^{-2}	-56×10^{-2}	14×10^{-2}
t-value	-0.75	-1.20	0.43
% impact	-18.0	-32.8	13.8
covariance	0.02	0.12	0.06
% Δ Length of Stay			
coefficient	68×10^{-1}	77×10^{-1}	53×10^{-1}
t-value	4.44	3.71	2.91
% Δ ECF			
coefficient	21×10^{-1}	20×10^{-1}	12×10^{-1}
t-value	4.54	2.79	2.59
% Δ MD Concentration			
coefficient			31×10^{-1}
t-value			2.75
Farm			
coefficient	65×10^{-1}	85×10^{-1}	72×10^{-1}
t-value	3.66	2.81	3.98
R^2	0.27	0.24	0.25
Determinant	0.90	0.78	0.76
Constant	12×10^{-1}	14×10^{-1}	67×10^{-2}

As would be expected from the annual analyses, the impact of the Indiana Program is negative in the Michigan equation. However, its effect is narrowly insignificant at the .10 level. In the other two equations the Program's influence is highly insignificant.

Like the other component costs, the percentage changes in length of stay and ECF involvement exert positive influences on the percentage change in capital cost. Farm population is also a strong determinant of this variable, exerting a positive influence in all three equations. The only other significant determinant is the percentage change in physician concentration, which has a positive impact in the Tristate equation.

As noted earlier, in the Michigan capital cost comparisons there is an inconsistency between the findings of the annual and percentage change analyses. This inconsistency is also present, but to a lesser degree, in the Combined equations. It is probable that a major factor accounting for this inconsistency is the much greater variation in the percentage change in capital cost when compared to the percentage changes in the other component costs. In the Michigan analyses the coefficient of variation for the percentage change in capital cost is 1.71, while this statistic for the percentage changes in labor and supply/service costs is respectively .55 and .47.

This greater variation, part of which is due to idiosyncratic factors, makes it less likely that any systematic variable such as the Indiana Program will have a significant impact on the percentage change in capital cost. In addition, the inconsistency in the Michigan analyses is softened by the negative, albeit insignificant, influence of the Indiana Program on the percentage change in capital cost and by the still positive but insignificant influence of the Indiana Program on 1973 capital cost.

Labor Usage

Overall Results

Findings -- It was hypothesized that the Indiana Program would have a strong negative influence on wage level in 1973 and a weaker but significant negative impact on this variable in 1968. Correspondingly, it was expected that the Program would have a negative effect on the percentage change in wage level.

As shown in Table 16-12, these expectations are partially supported by the results. In the Combined analyses the Program has a negative effect on wage level in both study years, but its influence in 1968 is almost as strong as its impact in 1973, -6% versus -7%. The Program's impact on the percentage change in wage level is insignificant. However, since wage level increases substantially during

the study years, the Program's absolute influence rises concomitantly. The Program reduces wage level by 14¢ in 1968 and by 21¢ in 1973.

The Program has a stronger influence on wage level in the Michigan analyses than in the Combined analyses. In both study years its impact is -13% in the Michigan comparisons. The Tristate results stand in sharp contrast to both the Michigan findings and the Chapter 14 hypotheses. In these analyses the Program not only has an insignificant influence on the percentage change in wage level, but an insignificant impact on this variable in both 1973 and 1968.

Table 16-12

IMPACT OF INDIANA PROGRAM ON WAGE LEVEL

	COMBINED	MICHIGAN	TRISTATE
1973	-7%	-13%	0
1968	-6%	-13%	0
% Δ	0	0	0

It was anticipated that the Indiana Program would have a negative impact on skill mix in 1973 and a weaker negative influence on this variable in 1968. Accordingly, it was hypothesized that the Program would have a negative effect on the percentage change in skill mix.

The results partially support these hypotheses, as shown in Table 16-13. Analogous to the wage level findings, in the Combined analyses the Program has a negative impact on skill mix. The magnitude of this effect is almost the same in 1973 and 1968, -4% and -3% respectively. The Indiana system has an insignificant effect on the percentage change in skill mix.

In these analyses it is the Tristate findings which are similar to the Combined results. In the Tristate analyses the Program has a -4% impact on skill mix in both study years, as well as an insignificant effect on the percentage change in this variable. In contrast, the Program's effects on skill mix are uniformly insignificant in the Michigan analyses.

Table 16-13

IMPACT OF INDIANA PROGRAM ON SKILL MIX

	COMBINED	MICHIGAN	TRISTATE
1973	-4%	0	-4%
1968	-3%	0	-4%
% Δ	0	0	0

It was hypothesized that wage level and skill mix would have strong positive effects on average salary. It was further expected that both wage level and skill mix would transmit a sizeable fraction of the Indiana Program's influence on average salary, but that wage level would be somewhat more important in this regard.

These expectations are largely supported by the findings. Since wage level and skill mix are continuous variables, the elasticity coefficient is the appropriate measure of the influence of each on average salary. The elasticity coefficient is used for a similar purpose in Chapter 13 and is defined in Chapter 6. In these analyses it indicates the percentage change in average salary expected as a result of a given percentage change in either wage level or skill mix.

As shown in Table 16-14, wage level has a strong positive impact on average salary in both study years and in all control groups. With the partial exception of the Tristate analyses, its influence is markedly greater in 1973 than in 1968. In the Combined analyses wage level's effect on average salary is +76% and +45% respectively in these two years. However, representing a significant departure from the Chapter 14 hypotheses, the percentage change in wage level has an insignificant effect on the percentage change in average salary in all three analyses.

Table 16-14

EFFECT OF WAGE LEVEL ON AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
1973	+76%	+80%	+66%
1968	+45%	+47%	+59%
% Δ	0	0	0

The skill mix findings are somewhat similar to the wage level results. As indicated in Table 16-15, in all three analyses skill mix has a powerful positive influence on average salary in both 1973 and 1968. However, the difference between its effects in 1973 and 1968 is less marked than the corresponding difference for wage level. In fact, in the Michigan comparisons skill mix has a stronger influence on average salary in 1968 than in 1973. Analogous to the wage level analyses, the percentage change in skill mix has an insignificant effect on the percentage change in average salary in the Combined and Tristate analyses. In contrast, the percentage change in skill mix exerts a positive influence on the percentage change in average salary in the Michigan comparison.[1]

Table 16-15

EFFECT OF SKILL MIX ON AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
1973	+72%	+108%	+65%
1968	+65%	+125%	+48%
% Δ	0	+4%	0

The impact of the Indiana Program on average salary was determined in Segment I. Even so, to establish a firm baseline for determining the transmitting effects of wage level and skill mix, the Program's influence on average salary was reassessed for the Segment II labor usage hospitals. The results of both analyses are shown in Table 16-16.

In the Combined comparisons the Program's impact on average salary is almost precisely the same in these analyses and the Segment I analyses. The only difference is that in 1968 its impact in these analyses is -7% and its effect in the Segment I analyses is -8%. In the Michigan analyses the differences are greater, but still relatively modest. The greatest divergence occurs in 1973, where the Program has a -15% influence in these analyses and a -12% impact in the Segment I analyses.

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[1] In this relationship the elasticity coefficient is low, +4%. However, analogous to similar Segment I results, this result is primarily due to the very low mean of the percentage change in skill mix (1%) and to the high mean of the percentage change in average salary (44%).

In 1968 the difference is small, -10% in these analyses compared to -9% in the Segment I analyses. The Program's effect on the percentage change in average salary is identical in the two sets of analyses.

Table 16-16

IMPACT OF INDIANA PROGRAM ON AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
1973	-8% (-8%)*	-15% (-12%)	-6% (-4%)
1968	-7% (-8%)	-10% (-9%)	-6% (-7%)
% Δ	0 (0)	-16% (-16%)	0 (0)

*Segment I results are shown in parentheses.

In the Tristate comparisons the differences are even more modest than in the Michigan analyses. In these analyses the Program's impact in 1973 is -6% compared to -4% in the Segment I analyses. The respective figures for 1968 are -6% and -7%. In both analyses the Program has an insignificant impact on the percentage change in average salary.

The impact of the Indiana Program on average salary transmitted through wage level approximates the Program's impact on wage level multiplied by wage level's effect on average salary. The same algorithm holds for skill mix. A similar approach is employed in Chapter 13 to determine the extent to which different endogenous variables transmit the impact of the Indiana Program on total cost.

Table 16-17 incorporates this approach and indicates the relative magnitude of the transmitting effects of wage level and skill mix in the Combined analyses. In this table the first column is drawn directly from data in Table 16-16. The second column is calculated from data displayed in Tables 16-12 and 16-14. For example, using the formula indicated above, the impact of the Indiana Program on average salary transmitted through wage level in the 1973 Combined analysis equals the Program's impact on wage level (-7%) multiplied by wage level's effect on average salary (+76%), or -5%. The third column in this table is analogous to the second column, in that it displays the transmitting effects of skill mix. The fourth column is the sum of the second and third columns, and the fifth column equals the fourth column subtracted from the first.

Table 16-17

ANALYSIS OF THE PROGRAM'S IMPACT ON
AVERAGE SALARY IN THE COMBINED COMPARISONS

	Impact of Indiana Program on . . .				
	Average Salary	Average Salary Transmitted Through Wage Level	Average Salary Transmitted Through Skill Mix	Average Salary Transmitted Through Both Wage Level and Skill Mix	Residual Impact of Indiana Program on Average Salary
1973	-8%	-5%	-3%	-8%	0
1968	-7%	-3%	-2%	-5%	-2%
% Δ '68-'73	0	0	0	0	0

In the Combined analyses both wage level and skill mix are substantial transmitters of the Indiana Program's impact on average salary. In 1973 wage level transmits a -5% impact on average salary, and skill mix transmits a -3% influence. Similarly, in 1968 wage level and skill mix transmit respectively a -3% and a -2% impact on average salary. In both study years the transmitting effect of wage level is thus higher than that of skill mix, but the difference is not striking.

The transmitting effects of these two variables explain all of the Program's impact on average salary in 1973; and almost all of its influence in 1968, where the Program's residual impact is -2%, i.e., much less than its -7% influence on average salary. In the percentage change analyses the Program does not have a significant impact on the percentage change in average salary and there are no significant transmitting effects of wage level or skill mix.

In the Michigan analyses the Indiana Program does not have a significant impact on skill mix. As shown in Table 16-18, this variable thus does not transmit the Program's influence on average salary in these analyses. Such is not the case for wage level, which transmits more than one half of the Program's impact on average salary in both 1973 and 1968. These analyses do not indicate that wage level transmits the Program's effect on the percentage change in average salary. However, they do show that the transmitting effect of wage level is substantially greater in 1973 than in 1968, -11% compared to -6%. These results thus demonstrate the importance of wage level in transmitting the Program's impact on average salary in the Michigan analyses.

Table 16-18

ANALYSIS OF THE PROGRAM'S IMPACT ON
AVERAGE SALARY IN THE MICHIGAN COMPARISONS

	Impact of Indiana Program on . . .				
	Average Salary	Average Salary Transmitted Through Wage Level	Average Salary Transmitted Through Skill Mix	Average Salary Transmitted Through Both Wage Level and Skill Mix	Residual Impact of Indiana Program on Average Salary
1973	-15%	-11%	0	-11%	-4%
1968	-10%	-6%	0	-6%	-4%
% Δ '68-'73	-16%	0	0	0	-16%

In contrast to the Michigan results, the Program has an insignificant influence on wage level in the Tristate analyses, and thus wage level is not a significant transmitting factor in these comparisons. As displayed in Table 16-19, this is not the case for skill mix, which is a significant transmitting factor in both study years. Skill mix transmits one half of the Program's influence on average salary in 1973 and one third of its impact in 1968. Although the Program's residual impact on average salary is thus proportionately higher in the Tristate analyses than in the Combined or Michigan comparisons, these results nonetheless establish the importance of skill mix as a transmitting factor in the Tristate comparisons.

Table 16-19

ANALYSIS OF THE PROGRAM'S IMPACT ON
AVERAGE SALARY IN THE TRISTATE COMPARISONS

	Impact of Indiana Program on . . .				
	Average Salary	Average Salary Transmitted Through Wage Level	Average Salary Transmitted Through Skill Mix	Average Salary Transmitted Through Both Wage Level and Skill Mix	Residual Impact of Indiana Program on Average Salary
1973	-6%	0	-2%	-2%	-4%
1968	-6%	0	-2%	-2%	-4%
% Δ '68-'73	0	0	0	0	0

It was anticipated that the Indiana Program would have a negative influence on unionization in 1973 and a more modest negative influence on this variable in 1968. It was also hypothesized that the Program would have a negative impact on the percentage change in unionization.

The results largely support these hypotheses and do so entirely in the Michigan analyses, as indicated in Table 16-20. The Program has a -58% impact on unionization in 1973 and a smaller -37% influence on this variable in 1968. Accordingly, its influence on the percentage change in unionization is -90%. In the Tristate comparisons the Program has a significant negative influence on unionization in both 1968 and 1973, but its impact in the earlier year (-51%) exceeds its influence in the latter year (-34%). As a result, the Program has an insignificant influence on the percentage change in unionization.

Table 16-20

IMPACT OF INDIANA PROGRAM ON UNIONIZATION

	COMBINED	MICHIGAN	TRISTATE
1973	-36%	-58%	-34%
1968	-47%	-37%	-51%
% Δ	-100%	-90%	0

In the Combined analyses the Program has a -36% impact on unionization in 1973 and a larger -47% influence on unionization in 1968. The Program's impact on the percentage change in unionization is also negative, -100%. While the Combined and Tristate findings may appear contradictory, this is not the case. In the Combined and Tristate analysis groups the increases in unionization are 33% and 8% respectively. Hence, in the Combined results the lower percentage impact of the Indiana Program on 1973 unionization is offset by the larger magnitude of unionization in that year.

It was expected that unionization would have a negative impact on wage level. It was further hypothesized that unionization would transmit a substantial fraction, but less than one half, of the Program's impact on wage level.

The elasticity results showing the effect of unionization on wage level are displayed in Table 16-21.[2] In 1973 unionization has a significant positive influence on wage level in all three analyses. Its impact is greatest in the Michigan comparison (+7%), intermediate in the Combined comparison (+5%), and lowest in the Tristate analysis (+3%). Somewhat surprisingly, unionization does not have a significant influence on 1968 wage level and the percentage change in unionization has an insignificant impact on the percentage change in wage level. These findings hold in all three analyses.

Table 16-21

EFFECT OF UNIONIZATION ON WAGE LEVEL

	COMBINED	MICHIGAN	TRISTATE
1973	+5%	+7%	+3%
1968	0	0	0
% Δ	0	0	0

Therefore, unionization cannot have a significant transmitting effect in either the 1968 or the percentage change analyses of wage level. The latter result is unimportant since the Indiana Program does not have a significant impact on the percentage change in wage level. The former finding is of greater significance since it means that unionization does not significantly transmit the Program's negative impact on 1968 wage level.

However, an appreciable transmitting effect of unionization is possible in 1973. Table 16-22 examines this possibility. In the Combined analysis the Program's impact on wage level is -7% and its influence on wage level transmitted through unionization is -2%. Unionization therefore transmits about one fourth of the Program's effect on wage level in 1973.

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[2] The unionization index is less continuous than the wage level and skill mix indices. Nonetheless, it can take on sufficient values (the integers between 1 and 7) to warrant the use of the elasticity coefficient, rather than a statistic analogous to the percentage impact statistic of the Indiana Program.

Table 16-22

ANALYSIS OF THE PROGRAM'S IMPACT ON WAGE LEVEL IN 1973

	Impact of Indiana Program on ...		
	Wage Level	Wage Level Transmitted Through Unionization	Residual Impact of Indiana Program on Wage Level
COMBINED	-7%	-2%	-5%
MICHIGAN	-13%	-4%	-9%
TRISTATE	0	-1%	-1%

The Michigan results are similar. The Program's influence on wage level is -13% and its impact on wage level transmitted through unionization is -4%; unionization again transmits approximately one fourth of the Program's effect on wage level. In the Tristate analyses the Indiana Program's impact on wage level is insignificant. The unionization results are consistent with this finding, for they indicate that a -1% impact on wage level is transmitted through unionization -- an impact too small to be statistically significant.

Interpretation -- In the Combined analyses the Indiana Program has a negative impact on both wage level and skill mix. Its influence on each variable is approximately the same in 1973 and 1968. Accordingly, the Program has an insignificant effect on the percentage changes in these variables. Consistent with these results, both wage level and skill mix play important roles in transmitting the Program's influence on average salary. In this regard wage level is the more important of the two variables, but there is only a modest difference in the magnitude of the transmitting effects.

The Michigan and Tristate analyses present an interesting contrast. In the Michigan comparisons the Program has a strong negative effect on wage level, but an insignificant influence on skill mix. In the Tristate analyses the Program has a substantial negative influence on skill mix, but an insignificant impact on wage level. Correspondingly, wage level is the main factor transmitting the Program's influence on average salary in the Michigan analyses and skill mix is the prime factor transmitting the Program's impact on average salary in the Tristate comparisons.

The rationale for the contrasting Michigan/Tristate results is not clear. It is unlikely that the Michigan planning program is a major causative factor. This being the case, it is inadvisable to emphasize the differences between the Michigan and Tristate results. Instead, it is appropriate to stress the Combined findings which point up the importance of both wage level and skill mix as variables transmitting the Program's influence on average salary.

As part of these analyses the Program's impact on average salary was assessed for the labor usage sample. Its effects in this sample strongly conform to its effects in the Segment I analyses, especially in the Combined comparisons where the results are almost the same. These findings further strengthen the methodologic basis of these analyses.

The Indiana Program has a strong negative impact on unionization in all study time periods. Unionization does not have a significant effect on wage level in 1968 and thus does not transmit the Program's influence on this variable in that year. In contrast, in 1973 it is a significant transmitting factor. In that year it transmits about one quarter of the Program's impact on wage level.

These analyses significantly extend the study results discussed earlier. Central among those results is the importance of average salary as a pathway for the Program's influence on total cost in both 1968 and 1973. The findings here indicate that both wage level and skill mix are important in achieving the average salary effect, and by extension, the labor cost effect. They also indicate that unionization plays a significant, but not dominant, role in producing the wage level effect in 1973.

Earlier results show that average salary makes only a moderate contribution to the Program's impact on the change in cost. Instead, the variables primarily responsible are labor productivity and supply/service cost. These analyses illuminate those findings by indicating that the labor productivity and supply/service gains were achieved without increasing skill mix or wage level.

These results are especially important for labor productivity. Analogous to average salary, this variable is determined by skill mix and individual productivity (output per person for different personnel types). Illustrating this relationship, since labor productivity is defined as total output divided by total FTEs, it may be comparatively high (or low) because the hospital uses a large (or small) percentage of skilled personnel and/or because the productivity of different personnel types is high (or low).

Both skill mix and individual productivity have positive effects on labor productivity. Unlike skill mix, data limitations prevented the direct analysis of individual productivity in this study. However, the study findings make it possible to deduce the Indiana system's influence on this variable.

As indicated in Table 16-23, in 1968 the Program's influence on skill mix is negative and its effect on labor productivity is insignificant. Consequently, its impact on individual productivity in that year must be positive. Its 1973 impact on skill mix is negative and similar in magnitude to its 1968 effect. However, its influence on labor productivity is positive in 1973. Its 1973 impact on individual productivity must therefore be positive and stronger than its 1968 influence. By analogous logic the Program's effect on the percentage change in individual productivity must also be positive.

Table 16-23

EFFECTS ON LABOR PRODUCTIVITY
AND ITS DETERMINANTS

	Skill Mix	Individual Productivity	Labor Productivity
1973	↓↓	↑↑↑↑	↑↑
1968	↓↓	↑↑	0
Change between 1968 and 1973	0	↑↑	↑↑

The Program's increasing positive impact on labor productivity thus stems from its rising positive influence on individual productivity, which is strong enough to overcome the Program's negative effect on skill mix. That is, the Program increases labor productivity not by inducing hospitals to employ more skilled personnel. In fact, for the reasons discussed earlier Indiana hospitals have shifted to a less skilled personnel mix. Instead, the Program impacts labor productivity by stimulating hospitals to increase the productivity of individual employees. Moreover, Indiana hospitals accomplished this result without raising their wage rates (as compared to the control hospitals).

Detailed Findings

As indicated in Chapter 15, because of data availability the labor usage sample includes only 90 Segment II hospitals. It is therefore necessary to compare the labor usage hospitals with the non-labor usage hospitals in Segment II. Comparison tests analogous to those used in Chapter 5 were employed for this purpose. One, termed Test B, compares Indiana labor usage hospitals with Indiana non-labor usage hospitals; the other, termed Test C, compares all labor usage hospitals

with all non-labor usage hospitals. The detailed results of these tests are shown in Appendix B.

In Test B there are only eight significant differences in terms of the 75 Segment II variables. The Test C results are similar: they indicate the presence of seven significant differences across the same variables. None of the differences are large in magnitude. The highest correlation between a comparison variable and the labor usage indicator variable is .35. The degree of common variation between the latter variable and any comparison variable is consequently less than 13%.

In both tests there is no significant difference in average salary -- an important result since this variable is a primary focus of these analyses. Similarly, there is no significant difference in labor productivity between the labor usage and non-labor usage hospitals. The same applies to labor cost in both 1973 and 1968. Test B indicates no significant difference in the percentage change in labor cost, while Test C shows a difference modestly significant at the .05 level in this percentage change variable.

The characteristics of the labor usage and non-labor usage hospitals are thus similar. The significant differences are infrequent. Those that do exist are neither sufficiently large nor strike such key variables that they threaten the methodologic basis of the labor usage analyses. Instead, the conclusion is the reverse. Accordingly, the labor usage findings can be generalized to the Segment II sample, and by extension to the Indiana hospital universe.

The predictive power of the wage level annual analyses is markedly higher in 1973 than in 1968, but even in the latter year it is not low. As displayed in Table 16-24, the 1973 Michigan equation has the highest R^2 (.59) and the 1968 Combined and Tristate equations have the lowest R^2s (.31). Collinearity involving the Indiana Program is extremely low, with the Program's covariance ratio never exeeding .05. Overall collinearity is higher, but still modest: the determinant ranges from .87 to .27.

The effect of the Indiana Program in the Michigan analyses is negative and significant at the .001 level in both 1973 and 1968. It is significant at that level in the 1973 Combined equation and at the .01 level in the 1968 Combined comparison. In the Tristate analyses the impact of the Indiana Program is also negative. Further, its effect is significant at the .10 level in the 1973 equation. The Program's influence is clearly insignificant in the 1968 comparison.

As expected, income level has a positive impact on wage level in all the equations. White population has a negative influence in all but the 1968 Michigan and Tristate equations. Education level also has a negative effect, but its influence is confined to the 1968 equations and to the 1973 Combined comparison. The two remaining determinants -- farm population and nonprofit control -- also have negative effects but only in 1973.

Table 16-24

ANNUAL ANALYSES OF WAGE LEVEL

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-21×10^{-2}	-14×10^{-2}	-44×10^{-2}	-32×10^{-2}	-75×10^{-3}	-24×10^{-3}
t-value	-3.73	-2.56	-5.93	-4.23	-1.50	-0.65
% impact	-7.1	-5.9	-13.4	-13.0	-2.6	-1.1
covariance	0.03	0.02	0.02	0.01	0.03	0.05
Nonprofit Control						
coefficient	-17×10^{-2}		-16×10^{-2}			
t-value	-2.65		-2.01			
Income						
coefficient	89×10^{-6}	92×10^{-6}	70×10^{-6}	90×10^{-6}	62×10^{-6}	93×10^{-6}
t-value	3.04	3.78	2.01	2.76	2.12	5.52
White						
coefficient	-15×10^{-1}	-80×10^{-2}	-17×10^{-1}		-14×10^{-1}	
t-value	-2.98	-1.88	-3.02		-2.69	
Farm						
coefficient	-19×10^{-2}				-70×10^{-2}	
t-value	-2.91				-1.91	
Education						
coefficient	-17×10^{-2}	-20×10^{-2}		-25×10^{-2}		-10×10^{-2}
t-value	-2.80	-3.60		-3.16		-2.68
R^2	0.49	0.31	0.59	0.39	0.45	0.31
Determinant	0.27	0.64	0.58	0.87	0.36	0.77
Constant	59×10^{-1}	46×10^{-1}	43×10^{-1}	46×10^{-1}	37×10^{-1}	25×10^{-1}

As shown in Table 16-25, the predictive power of the wage level percentage change analyses is low, but still higher than that of the average salary percentage change equations in both this segment and Segment I. The R^2s range from .20 to .12. Collinearity is low in these equations. The Program's covariance ratio ranges from .01 to .14, and the determinant approximates .80.

The effect of the Indiana Program is negative in all three comparisons. While its t-value exceeds -1.00 in each equation, the Program's influence is nonetheless insignificant even at the .10 level in all the equations. Consistent with the annual analyses, farm population, nonprofit control, and white population have negative effects on the percentage change in wage level. Fiscal year is the only other significant determinant; its influence is also negative.

Table 16-25

PERCENTAGE CHANGE ANALYSES OF WAGE LEVEL

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-26×10^{-3}	-36×10^{-3}	-28×10^{-3}
t-value	-1.12	-1.01	-1.15
% impact	-7.5	-10.2	-8.4
covariance	0.01	0.14	0.05
Fiscal Year			
coefficient	-76×10^{-4}	-16×10^{-3}	
t-value	-2.06	-2.78	
Nonprofit Control			
coefficient	-53×10^{-3}		-53×10^{-3}
t-value	-2.06		-1.91
White			
coefficient			-67×10^{-2}
t-value			-2.84
Farm			
coefficient	-40×10^{-2}	-38×10^{-2}	
t-value	-3.07	-1.94	
R^2	0.14	0.20	0.12
Determinant	0.76	0.85	0.79
Constant	46×10^{-2}	49×10^{-2}	10×10^{-1}

The predictive power of the skill mix annual analyses is substantial, although lower than that of the wage level annual analyses. Like the latter, it is higher in 1973 than in 1968, but the difference is not marked. As indicated in Table 16-26, the R^2 ranges from .47 in the 1973 Tristate comparison to .22 in the 1968 Michigan equation. Collinearity is again low in these equations. The Program's covariance ratio ranges from .05 to .18 and the determinant from .74 to .39.

In the Tristate analyses the influence of the Indiana Program is significant at the .001 level in both study years. The same holds for the 1973 Combined equation. In the 1968 Combined comparison the effect of the Program is almost significant at the .01 level. In the Michigan equations the impact of the Indiana Program is negative but clearly insignificant.

Income level has a positive impact on skill mix in all the equations. ECF involvement has a consistently negative influence on skill mix, while medical education involvement has a positive impact, albeit only in the Michigan equations. Education level has a positive effect on skill mix in the 1968 Combined and Tristate analyses. Bed size

and length of stay have positive and negative effects respectively in the 1973 Combined and Tristate equations.

Table 16-26

ANNUAL ANALYSES OF SKILL MIX

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-52×10^{-3}	-35×10^{-3}	-13×10^{-3}	-83×10^{-5}	-51×10^{-3}	-54×10^{-3}
t-value	-3.54	-2.30	-0.68	-0.04	-3.30	-3.39
% impact	-3.6	-2.5	-0.9	-0.1	-3.6	-3.8
covariance	0.08	0.06	0.06	0.05	0.18	0.13
Length of Stay						
coefficient	-19×10^{-3}				-27×10^{-3}	
t-value	-2.82				-3.04	
ECF						
coefficient	-37×10^{-2}	-23×10^{-2}	-46×10^{-2}		-25×10^{-2}	-32×10^{-2}
t-value	-3.00	-2.07	-2.29		-1.99	-2.95
Bed Size						
coefficient	10×10^{-5}				10×10^{-5}	
t-value	2.00				1.91	
Medical Education						
coefficient			61×10^{-2}	71×10^{-2}		
t-value			2.19	1.70		
Income						
coefficient	22×10^{-6}	19×10^{-6}	15×10^{-6}	17×10^{-6}	27×10^{-6}	18×10^{-6}
t-value	3.48	3.02	1.67	1.96	3.85	2.42
Education						
coefficient		35×10^{-3}				31×10^{-3}
t-value		2.24				1.87
R^2	0.42	0.30	0.37	0.22	0.47	0.37
Determinant	0.49	0.74	0.61	0.71	0.39	0.65
Constant	13×10^{-1}	79×10^{-2}	12×10^{-1}	12×10^{-1}	13×10^{-1}	88×10^{-2}

The predictive power of the skill mix percentage change analyses is low, as it is in the wage level percentage change analyses. As shown in Table 16-27, the R^2 ranges narrowly from .17 to .09. Collinearity is low in these equations, with the Program's covariance ratio never exceeding .05 and the determinant never falling below .73.

In all three comparisons the influence of the Indiana Program is negative, and in the Combined and Michigan equations it is clearly insignificant. In contrast, in the Tristate equation the influence of the Program is almost significant at the .05 level.

Table 16-27

PERCENTAGE CHANGE ANALYSES OF SKILL MIX

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-57×10^{-4}	-11×10^{-4}	-12×10^{-3}
t-value	-0.87	-0.14	-1.64
% impact	-29.9	-7.4	-53.3
covariance	0.02	0.03	0.05
% Δ Length of Stay			
coefficient	-77×10^{-3}	-73×10^{-3}	
t-value	-2.29	-2.09	
% Δ MD Concentration			
coefficient	36×10^{-3}		
t-value	1.73		
Elderly Caseload			
coefficient	-71×10^{-3}	-13×10^{-2}	
t-value	-1.91	-2.87	
Income			
coefficient			69×10^{-7}
t-value			2.02
Education			
coefficient			-16×10^{-3}
t-value			-2.06
R^2	0.12	0.17	0.09
Determinant	0.73	0.87	0.77
Constant	38×10^{-3}	57×10^{-3}	15×10^{-2}

The percentage change in length of stay has a negative influence in the Combined and Michigan equations, which is consistent with the impact of length of stay in the annual analyses. Elderly caseload also has a negative impact in these equations. The two determinants in the Tristate equation -- income level and education level -- have positive and negative effects respectively, which is consistent with their influence in the annual analyses. The remaining determinant is the percentage change in physician concentration, which has a positive impact in the Combined comparison.

The predictive power of the unionization annual analyses is sizeable, approximating that of the wage level and skill mix annual analyses. As displayed in Table 16-28, the R^2 ranges from .59 in the 1973 Michigan equation to .25 in the 1968 Combined comparison. As with wage level and skill mix, the R^2s are distinctly higher in the 1973 equations. Similar to the other labor usage analyses, collinearity is low in these equations. The Program's covariance ratio is .22 in

the 1973 Tristate comparison, but never exceeds .08 in the other equations. The determinant is also lowest in the 1973 Tristate comparison (.67); its value is highest in the 1968 Michigan equation (.87).

Table 16-28

ANNUAL ANALYSES OF UNIONIZATION

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-80×10^{-2}	-86×10^{-2}	-16×10^{-1}	-56×10^{-2}	-68×10^{-2}	-10×10^{-1}
t-value	-2.32	-2.93	-4.74	-2.50	-1.96	-3.31
% impact	-36.3	-46.8	-57.7	-36.6	-34.2	-50.6
covariance	0.08	0.01	0.03	0.06	0.22	0.03
ECF						
coefficient	11×10^{0}		14×10^{0}		95×10^{-1}	
t-value	3.95		4.14		3.48	
Emergency/Outpatient						
coefficient	-19×10^{0}	-20×10^{0}	-20×10^{0}	-13×10^{0}	-12×10^{0}	
t-value	-3.75	-3.39	-4.30	-3.02	-2.04	
Elderly Caseload						
coefficient		-28×10^{-1}	-38×10^{-1}	-35×10^{-1}		
t-value		-1.80	-2.06	-2.87		
Medical Education						
coefficient						30×10^{0}
t-value						2.33
Nonprofit Control						
coefficient		-59×10^{-2}		-66×10^{-2}		
t-value		-1.85		-3.02		
MD Concentration						
coefficient	13×10^{-3}	13×10^{-3}			25×10^{-3}	23×10^{-3}
t-value	2.72	2.35			4.43	3.33
White						
coefficient						81×10^{-1}
t-value						2.73
R^2	0.41	0.25	0.59	0.34	0.47	0.34
Determinant	0.80	0.79	0.84	0.87	0.67	0.69
Constant	28×10^{-1}	37×10^{-1}	60×10^{-1}	41×10^{-1}	10×10^{-1}	-76×10^{-1}

The influence of the Indiana Program is significant at the .001 level in the 1973 Michigan and the 1968 Tristate equations. It is significant at the .01 level in the 1968 Combined and Michigan equations, and almost significant at that level in the 1973 Combined comparison. The Indiana Program exhibits its lowest t-value (-1.96) in the 1973

Tristate comparison, which indicates that even in this equation the Program's influence is solidly significant at the .05 level.

Emergency/outpatient involvement has a negative influence on unionization in all equations but the 1968 Tristate equation. In contrast, ECF involvement is a powerful positive determinant of unionization in all 1973 equations. Physician concentration also has a positive influence on this factor in the Combined and Tristate equations. Elderly caseload has a negative effect on unionization, which is strongest in the Michigan analyses. The remaining determinants are nonprofit control, white population, and medical education involvement. The former has a negative influence in the 1968 Combined and Michigan equations, while the latter two variables have positive effects but only in the 1968 Tristate comparison.

As shown in Table 16-29, the predictive power of the unionization percentage change analyses is higher than that of the wage level and skill mix percentage change analyses. In fact, in the Michigan equation the R^2 almost reaches .50. Collinearity is extremely low in these equations. The Program's covariance ratio is never higher than .05 and the determinant is never lower than .89.

Table 16-29

PERCENTAGE CHANGE ANALYSES OF UNIONIZATION

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-54×10^{-2}	-11×10^{-1}	-97×10^{-3}
t-value	-2.59	-3.56	-1.25
% impact	-100.1	-89.6	-77.2
covariance	0.01	0.04	0.05
% Δ ECF			
coefficient	98×10^{-2}	18×10^{-1}	
t-value	3.66	4.18	
Nonprofit Control			
coefficient		56×10^{-2}	
t-value		1.88	
White			
coefficient			-12×10^{-1}
t-value			-1.80
Education			
coefficient	-72×10^{-2}	-94×10^{-2}	-23×10^{-2}
t-value	-3.60	-3.29	-3.11
R^2	0.27	0.49	0.15
Determinant	0.99	0.89	0.94
Constant	92×10^{-1}	12×10^{0}	41×10^{-1}

The Program's influence in the Michigan equation is significant at the .001 level, while its impact in the Combined comparison is significant at the .01 level. The Program's influence in the Tristate comparison is negative and almost significant at the .10 level.

Education level has a negative influence on unionization in all three equations. The percentage change in ECF involvement has a strong positive impact in the Combined and Michigan comparisons. Consistent with the annual analyses, nonprofit control has a positive effect in the Michigan equation and white population has a negative impact in the Tristate comparison.

The average salary annual analyses for the labor usage sample are shown in Table 16-30. The predictive power of these analyses is substantial, with the R^2s ranging from .70 to .32. In the Combined analyses the R^2s are similar to the Segment I results, but in the Michigan and Tristate analyses they are higher. Collinearity is low in the Combined and Tristate equations and modest in the Michigan analyses. The Program's covariance ratio ranges from .00 in the 1973 Combined equation to .18 in the 1973 Michigan comparison; the determinant ranges from .72 to .37.

Table 16-30

ANNUAL ANALYSES OF AVERAGE SALARY

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-58×10^{1}	-37×10^{1}	-12×10^{2}	-56×10^{1}	-42×10^{1}	-28×10^{1}
t-value	-3.47	-3.22	-5.77	-3.74	-2.43	-2.21
% impact	-8.0	-7.2	-14.8	-10.4	-5.9	-5.6
covariance	0.00	0.01	0.18	0.15	0.03	0.03
Bed Size						
coefficient			18×10^{-1}	80×10^{-2}		
t-value			3.11	1.78		
Medical Education						
coefficient	93×10^{2}	53×10^{2}			93×10^{2}	11×10^{3}
t-value	3.10	1.79			1.99	2.14
Fiscal Year						
coefficient			81×10^{0}	66×10^{0}		
t-value			2.43	2.61		
Income						
coefficient	16×10^{-2}	15×10^{-2}	17×10^{-2}	13×10^{-2}	14×10^{-2}	14×10^{-2}
t-value	2.16	2.94	1.76	1.85	1.80	2.35
White						
coefficient	-58×10^{2}	-30×10^{2}	-33×10^{2}	-25×10^{2}	-81×10^{2}	-29×10^{2}
t-value	-4.32	-3.27	-2.34	-2.41	-4.81	-2.32
R^2	0.48	0.41	0.70	0.60	0.46	0.32
Determinant	0.67	0.67	0.37	0.39	0.69	0.72
Constant	11×10^{3}	65×10^{2}	84×10^{2}	58×10^{2}	13×10^{3}	64×10^{2}

As in the Segment I analyses, the effect of the Indiana Program is significant at the .001 level in the Combined and Michigan analyses. In the Tristate comparisons the Program's impact is significant at the .01 level in the 1973 equation and at the .05 level in the 1968 equation.

Similar to the Segment I results, income level has a positive impact on average salary in all the equations. White population has a strong negative influence in these analyses. Medical education involvement has a positive impact in the Combined and Tristate equations, while bed size has a positive influence in the Michigan comparisons. The remaining determinant is fiscal year, which has a positive effect in the Michigan equations.

The predictive power of the average salary percentage change analyses is low, as it is in the Segment I findings. As displayed in Table 16-31, the R^2 is highest in the Michigan equation (.14) and lowest in the Combined and Tristate comparisons (.06). Collinearity is extremely low, reflecting the paucity of determinants in these equations. The Program's covariance ratio never exceeds .07 and the determinant never falls below .93.

Table 16-31

PERCENTAGE CHANGE ANALYSES OF AVERAGE SALARY

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-13×10^{-3}	-80×10^{-3}	-20×10^{-4}
t-value	-0.37	-1.80	-0.05
% impact	-3.0	-16.3	-0.4
covariance	0.00	0.07	0.03
% Δ Emergency/Outpatient			
coefficient		94×10^{-3}	
t-value		2.64	
MD Concentration			
coefficient	14×10^{-4}		
t-value	2.27		
White			
coefficient			-73×10^{-2}
t-value			-2.04
R^2	0.06	0.14	0.06
Determinant	1.00	0.93	0.97
Constant	33×10^{-2}	44×10^{-2}	11×10^{-1}

In the Michigan equation the influence of the Indiana Program is significant at the .05 level. The Program's effects in the other two equations are also negative but they are clearly insignificant.

As in the Segment I results, the percentage change in emergency/outpatient involvement has a positive impact on the percentage change in average salary in the Michigan equation. Consistent with the annual analyses, white population has a negative impact in the Tristate comparison. The significant determinant in the Combined equation is physician concentration, which has a positive influence.

Table 16-32 displays the annual analyses of average salary as a function of wage level and skill mix. These equations are used to determine the effects of the latter two variables on the former variable, which is a necessary element in the determination of the transmitting effects of wage level and skill mix. As emphasized earlier, if average salary, wage level, and skill mix were measured precisely, the latter two variables would fully explain the former because wage level and skill mix represent the two components of average salary. This being the case, only wage level and skill mix are included in these analyses. Even if the effects of one or both variables were insignificant in a specific equation, the variable(s) was still retained in the equation in order to demonstrate its effect. This possibility did not arise in the annual analyses, but it did occur in the percentage change analyses.

Table 16-32

ANNUAL ANALYSES OF AVERAGE SALARY
AS A FUNCTION OF WAGE LEVEL AND SKILL MIX

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Wage Level						
coefficient	18×10^2	10×10^2	19×10^2	10×10^2	16×10^2	13×10^2
t-value	7.92	4.61	7.24	4.15	4.54	3.42
% elasticity	75.7	45.4	80.2	46.9	66.1	59.2
covariance	0.00	0.01	0.00	0.01	0.05	0.00
Skill Mix						
coefficient	36×10^2	23×10^2	56×10^2	46×10^2	31×10^2	17×10^2
t-value	3.65	2.99	4.29	3.94	2.61	1.88
% elasticity	71.5	65.0	108.2	124.6	64.6	47.8
covariance	0.00	0.01	0.00	0.01	0.05	0.00
R^2	0.48	0.24	0.59	0.37	0.33	0.19
Determinant	1.00	0.99	1.00	0.99	0.95	1.00
Constant	-33×10^2	-52×10^1	-63×10^2	-36×10^2	-21×10^2	-34×10^1

The predictive power of these average salary analyses is sizeable, but not high. Like the other labor usage equations, the R^2s are markedly higher in the 1973 comparisons than in the 1968 analyses. Further, the predictive power of the Michigan equations is distinctly higher than that of the Tristate comparisons, with the Combined equations standing intermediate in this regard. The R^2s range from .59 in the 1973 Michigan comparison to .19 in the 1968 Tristate equation.

Collinearity is extremely low in these equations, reflecting the insignificant correlations between wage level and skill mix. The lowest value of the determinant is .95 in the 1973 Tristate equation, and the determinant is never below .99 in the other comparisons. The covariance ratios of both indices range from .00 to .05.

The effect of wage level is significant at the .001 level in all the analyses. The influence of skill mix is significant at that level in the Michigan comparisons and the 1973 Combined equation. It is significant at the .01 level in the 1968 Combined and the 1973 Tristate comparisons, while it is significant at the .05 level in the 1968 Tristate equation.

The percentage change analyses of average salary as a function of wage level and skill mix are shown in Table 16-33. The predictive power of these equations is low. The R^2s range from .09 to .03. As in the annual analyses, collinearity is essentially nonexistent in these equations, with the determinant equalling 1.00 in each comparison.

Table 16-33

PERCENTAGE CHANGE ANALYSES OF AVERAGE SALARY
AS A FUNCTION OF WAGE LEVEL AND SKILL MIX

	COMBINED	MICHIGAN	TRISTATE
% Δ Wage Level			
coefficient	23×10^{-2}	23×10^{-2}	30×10^{-2}
t-value	1.44	1.33	1.54
% elasticity	17.8	17.1	23.4
covariance	0.00	0.00	0.00
% Δ Skill Mix			
coefficient	41×10^{-2}	13×10^{-1}	40×10^{-2}
t-value	0.73	1.80	0.61
% elasticity	1.6	4.3	1.6
covariance	0.00	0.00	0.00
R^2	0.03	0.09	0.04
Determinant	1.00	1.00	1.00
Constant	34×10^{-2}	34×10^{-2}	31×10^{-2}

Only in the Michigan equation is the percentage change in skill mix significant at the .05 level; in the Combined and Tristate comparisons this variable is clearly insignificant. In all three equations the percentage change in wage level is significant at the .10 level. Its elasticity coefficient is similar in these equations, ranging from 17% in the Michigan comparison to 23% in the Tristate analysis where its t-value is also highest (1.54).

Several factors contribute to the largely insignificant effects of the percentage changes in wage level and skill mix on the percentage change in average salary. One is that wage level and skill mix are proxies, rather than precise measures, for their underlying factors. Another is that it has proven difficult in this study to predict the percentage change in average salary. Similarly, the predictive power of the percentage change analyses of wage level and skill mix is modest. It is thus likely that factors idiosyncratic to individual hospitals make it difficult to demonstrate systematic effects of wage level and skill mix on average salary in the percentage change analyses. Finally, even if wage level and skill mix could be measured precisely, the relationship between the percentage changes in these variables and the percentage change in average salary would not be as exact as that between the variables themselves and average salary.

Table 16-34 shows the annual analyses of wage level as a function of unionization. These analyses were employed to determine the effect of unionization on wage level -- a necessary step in the assessment of the transmitting effect of unionization. Both exogenous and semi-exogenous variables were included in these analyses, but the Indiana Program was excluded. As a result, the effect of unionization on wage level in these analyses is a modest overestimate since the Program has a negative impact on unionization and since the Program also has a negative effect on wage level. Hence, unionization is necessarily a partial proxy for the Indiana Program in these analyses.

If the Program had been included in these analyses, the result would have been a moderate underestimate of unionization's effect on wage level. This being the case, it was preferable to exclude the Program in order to avoid the possibility of inappropriately downgrading the effect of unionization. Fortunately, the difference between the two types of analyses is only modest. For example, in the 1973 Combined analysis, unionization's elasticity coefficient is 4.5% with the Indiana Program excluded from the equation, and 3.7% with the Program included. Therefore, the overall thrust of these analyses is the same regardless of whether the Indiana Program is included as an independent variable.

Compared to the earlier wage level analyses directed toward the impact of the Indiana Program (shown in Table 16-24), the predictive power of these equations is generally lower because the Indiana Program has a stronger impact on wage level than does unionization. The degree of collinearity in these equations is similar to that in the earlier

wage level analyses. Further, the effects of the other determinants of wage level are almost the same in the two sets of analyses.

Table 16-34

ANNUAL ANALYSES OF WAGE LEVEL
AS A FUNCTION OF UNIONIZATION

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Unionization						
coefficient	70×10^{-3}	13×10^{-3}	12×10^{-2}	26×10^{-3}	51×10^{-3}	15×10^{-3}
t-value	5.01	0.72	5.39	0.54	3.75	1.30
% elasticity	4.5	0.9	6.9	1.3	3.0	1.1
covariance	0.08	0.02	0.06	0.01	0.02	0.02
Nonprofit Control						
coefficient	-14×10^{-2}					
t-value	-2.22					
Income						
coefficient	11×10^{-5}	87×10^{-6}	12×10^{-5}	98×10^{-6}	10×10^{-5}	93×10^{-6}
t-value	3.96	3.48	3.25	2.58	4.87	5.63
White						
coefficient	-15×10^{-1}	-80×10^{-2}	-11×10^{-1}		-17×10^{-1}	
t-value	-3.11	-1.84	-1.95		-3.86	
Farm						
coefficient	-78×10^{-2}					
t-value	-1.97					
Education						
coefficient	-13×10^{-2}	-19×10^{-2}		-25×10^{-2}		-11×10^{-2}
t-value	-2.24	-3.25		-2.66		-2.79
R^2	0.55	0.26	0.53	0.18	0.51	0.32
Determinant	0.26	0.64	0.67	0.87	0.83	0.79
Constant	48×10^{-1}	44×10^{-1}	26×10^{-1}	42×10^{-1}	34×10^{-1}	25×10^{-1}

In all the 1973 equations the effect of unionization is significant at the .001 level. It is narrowly significant at the .10 level in the 1968 Tristate comparison and it is thoroughly insignificant in the other 1968 equations.

As shown in Table 16-35, the predictive power of the percentage change analyses of wage level as a function of unionization is approximately the same as that of the earlier wage level percentage change analyses (displayed in Table 16-25). The reason is that neither the Indiana Program nor the percentage change in unionization has a significant

impact on the percentage change in wage level. The degree of collinearity in the two sets of equations is also similar as are the effects of the determinants of the percentage change in wage level. The influence of the percentage change in unionization is positive in all three equations, but in none of the equations does it approach even the .10 level of significance.

Table 16-35

PERCENTAGE CHANGE ANALYSES OF WAGE LEVEL
AS A FUNCTION OF UNIONIZATION

	COMBINED	MICHIGAN	TRISTATE
% Δ Unionization			
coefficient	70×10^{-4}	54×10^{-4}	37×10^{-3}
t-value	0.68	0.47	1.04
% elasticity	0.7	0.8	0.9
covariance	0.00	0.01	0.03
Fiscal Year			
coefficient	-73×10^{-4}	-15×10^{-3}	
t-value	-1.97	-2.62	
Nonprofit Control			
coefficient	-52×10^{-3}		-46×10^{-3}
t-value	-2.02		-1.68
White			
coefficient			-58×10^{-2}
t-value			-2.44
Farm			
coefficient	-40×10^{-2}	-43×10^{-2}	
t-value	-3.03	-2.24	
R^2	0.13	0.18	0.11
Determinant	0.77	0.98	0.80
Constant	45×10^{-2}	46×10^{-2}	90×10^{-2}

Capital Usage

Overall Results

Findings -- It was hypothesized that in the Tristate analyses the Indiana Program would have negative effects on both capital expenditures and the percentage change in bed size. In contrast, it was anticipated that in the Michigan comparisons the Program would have an insignificant influence on capital expenditures, but a positive impact on the percentage change in bed size. It was further expected that in the Combined analyses the Program would have a modestly negative or insignificant influence on capital expenditures, and an insignificant impact on the percentage change in bed size.

These expectations are supported by the Michigan and Combined findings, but not by the Tristate results. As shown in Table 16-36, in the Tristate comparisons the Program has an insignificant influence on both capital expenditures and the percentage change in bed size. The same results hold in the Combined comparisons, although in this instance they were expected.

Table 16-36

IMPACT OF INDIANA PROGRAM ON CAPITAL EXPENDITURES AND PERCENTAGE CHANGE IN BED SIZE

	COMBINED	MICHIGAN	TRISTATE
CAPITAL EXPENDITURES	0	0	0
BED SIZE	0	+99%	0

In the Michigan analyses the Program has an insignificant effect on capital expenditures, but a strong positive influence on the percentage change in bed size, +99%. While this impact is substantial, it is less striking in absolute terms than in relative terms. The Program reduces the percentage change in bed size by an absolute amount of 8% -- a sizeable effect, but not as overwhelming as the Program's +99% impact might suggest.

Since in the Michigan analyses the Program's impact on the percentage change in bed size is significant, it is possible that part of its cost effect arises through this mechanism. In order for this possibility to occur, the percentage change in bed size must have a significant impact on the percentage change in cost. To determine whether such an effect is present, it is necessary to conduct Step C total cost analyses analogous to those discussed in Chapter 13. Such analyses indicate the impact of different endogenous variables on cost, taking into account the effects of other endogenous variables and semi-exogenous variables.

In these analyses the percentage change in bed size has an insignificant influence on the percentage change in cost. The same result is also obtained in Segment I in which the percentage change in bed size is considered a semi-exogenous variable. Therefore, the Program's negative influence on the percentage change in cost is neither enhanced nor diminished by the effect on the percentage change in bed size.

Interpretation -- In the Tristate comparisons the Indiana Program does not have an appreciable influence on capital usage. This finding is demonstrated in these analyses by the Program's insignificant effects on capital expenditures and the percentage change in bed size. The component cost analyses identify the Program's insignificant impact on capital cost and the Segment I analyses show its insignificant influence on capital intensity.

In these Michigan analyses the Indiana Program has an insignificant influence on capital expenditures, but a substantial positive effect on the percentage change in bed size. In the Segment I Michigan results the Program has a strong negative influence on the percentage change in capital intensity. Consistent with this finding, the Program's impact on capital intensity shifts from positive in 1968 to insignificant in 1973.

Since the Indiana Program has an insignificant influence on capital utilization in the Tristate analyses, the Michigan findings must be attributed to the Michigan planning program rather than to the Indiana system. They indicate that the Michigan program does not reduce capital expenditures, but rather shifts expenditures from bed construction to other purposes. The Michigan program therefore succeeds in slowing bed growth, but at the price of increasing capital intensity. The latter result was not intended by the Michigan system, but is consistent with that system's emphasis on the regulation of bed growth.

In terms of the Indiana Program, two central conclusions emerge from the capital sector analyses. First, despite its well-established planning component, the Indiana Program does not significantly affect hospital capital utilization, and hence does not reduce cost through this mechanism. Second, the Program's failure to influence capital utilization does not prevent it from reducing cost. It is thus clear that a prospective rate setting program can control hospital costs without impacting capital utilization.

Detailed Findings

The predictive power of the capital expenditures analyses is moderate, as shown in Table 16-37. The R^2s in these equations range from .30 to .22. Collinearity is low in these analyses, with the covariance ratio never exceeding .19 and the determinant never falling below .63. The effect of the Indiana Program is clearly insignificant in all three equations.

Bed size has a positive impact on capital expenditures in all three comparisons. In the Combined and Michigan equations white population has a negative impact; fiscal year also has a negative influence but only in the Michigan equation.

Table 16-37

ANALYSES OF CAPITAL EXPENDITURES

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	54×10^{1}	36×10^{1}	44×10^{1}
t-value	0.88	0.42	0.65
% impact	22.0	13.7	18.3
covariance	0.01	0.19	0.02
Bed Size			
coefficient	80×10^{-1}	86×10^{-1}	12×10^{0}
t-value	3.78	3.35	5.29
Fiscal Year			
coefficient		-26×10^{1}	
t-value		-1.80	
White			
coefficient	-13×10^{3}	-15×10^{3}	
t-value	-2.56	-2.55	
R^2	0.22	0.30	0.22
Determinant	0.77	0.63	1.00
Constant	13×10^{3}	17×10^{3}	31×10^{1}

As shown in Table 16-38, the predictive power of the percentage change analyses of bed size is low. The highest R^2 occurs in the Michigan equation (.15). Length of stay has a sizeable negative impact on this variable in all three equations, but there are no other significant determinants. Reflecting the presence of only two variables in these equations, collinearity is extremely low.

Table 16-38

PERCENTAGE CHANGE ANALYSES OF BED SIZE

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	63×10^{-3}	84×10^{-3}	45×10^{-3}
t-value	1.65	1.89	0.95
% impact	55.3	99.4	32.1
covariance	0.00	0.06	0.01
Length of Stay			
coefficient	-52×10^{-3}	-54×10^{-3}	-51×10^{-3}
t-value	-3.26	-2.94	-2.46
R^2	0.09	0.15	0.06
Determinant	1.00	0.94	0.99
Constant	52×10^{-2}	52×10^{-2}	53×10^{-2}

The influence of the Indiana Program is significant at the .05 level in the Michigan equation. It is clearly insignificant in the Tristate comparison. In the Combined equation the positive influence of the Indiana Program is narrowly insignificant at the .05 level.

17.
Effects on Financial Position and Shared/Contracted Services

While the majority of the Segment II analyses are discussed in the preceding chapter, this chapter addresses two noteworthy topics -- financial position and shared/contracted services. Both are significant areas not examined in Segment I, with financial position being especially important from an overall study perspective.

Financial Position

Overall Results

Findings -- It was hypothesized that the Indiana Program would have an insignificant influence on net worth in both 1968 and 1973. Accordingly, it was expected that the Program would have an insignificant effect on the percentage change in net worth.

As shown in Table 17-1, these expectations are largely supported by the findings. The Combined analyses entirely substantiate the Chapter 14 hypotheses since the Program's effects are insignificant throughout these analyses. The same result characterizes the Tristate comparisons. However, in the Michigan analyses the Program has a +20% impact on net worth in 1968 and an insignificant effect on this variable in 1973. Consistent with these results, the Program has a -57% influence on the percentage change in net worth.

Table 17-1

IMPACT OF INDIANA PROGRAM ON NET WORTH

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1968	0	+20%	0
% Δ	0	-57%	0

It was hypothesized that the Indiana Program would have an insignificant impact on working capital in both study years. Correspondingly, it was anticipated that the Program would have an insignificant influence on the percentage change in this variable.

These expectations are entirely supported by the results. As shown in Table 17-2, the Program has an insignificant influence on working capital, which holds for all study time periods and all control groups.

Table 17-2

IMPACT OF INDIANA PROGRAM ON WORKING CAPITAL

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1968	0	0	0
% Δ	0	0	0

It was anticipated that the Indiana Program would have an insignificant effect on profit margin in 1973 and 1968. It was thus expected that the Program would have an insignificant impact on the percentage change in this variable.

These hypotheses are largely unsupported by the findings, as indicated in Table 17-3. As expected, in the Combined analyses the Program's influence is insignificant in 1968. However, in 1973 it has a strong negative impact on profit margin, -190%. Although sizeable, its influence is less impressive in absolute terms than in relative terms. In 1973 the Program reduces profit margin by an absolute amount of 3%.[1] The percentage change result reflects the annual findings. The Program exerts a -168% influence on the percentage change in profit margin.

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[1] As with other variables, the sharp difference in the apparent magnitude of absolute and relative effects arises because average profit margin is low in 1973. As an approximation, these results indicate that if the control hospitals had been functioning under the Indiana Program, their average profit margin in 1973 would have been -4.6% rather than -1.6%, i.e., a relative difference of about -190%.

Table 17-3

IMPACT OF INDIANA PROGRAM ON PROFIT MARGIN

	COMBINED	MICHIGAN	TRISTATE
1973	-190%	-123%	-177%
1968	0	0	0
% Δ	-168%	0	-274%

The Tristate and Michigan findings are largely consistent with the Combined results. In these analyses the Program's influence is insignificant in 1968, and substantially negative in 1973. In the Tristate comparison the Program's impact on the percentage change in profit margin is also negative. However, unlike the Combined results, its influence on the percentage change variable is insignificant in the Michigan findings.

Interpretation -- The principal finding of these analyses is that the Indiana Program has little effect on financial position. Although the Program has a negative influence on profit margin in 1973 and on the percentage change in profit margin, this variable is the least important of the financial position variables because it is the least accurate indicator of true financial status.

The Program's influence on working capital is insignificant in all analyses, a finding which holds for net worth in the Combined and Tristate comparisons. In contrast, the Program has a significant effect on net worth in the Michigan analysis. However, in these comparisons its impact in 1968 is positive, not negative, with this effect fading to insignificance by 1973. Hence, in all the 1973 analyses the Indiana system has insignificant effects on both net worth and working capital.

The net worth results indicate that the Program has not damaged the bottom-line wealth position of hospitals. The working capital findings have almost equal significance. They show that the Indiana system has not hindered the hospital's ability to operate smoothly without cash flow crises.

These findings show that the Indiana Program is able to reduce cost without substantially weakening financial position. On the one hand, the findings are consistent with the study substantive framework, for

the Program has stressed hospital cooperation and has correspondingly not striven to reduce hospital financial status.

On the other hand, these results make it clear that prospective rate setting can lower cost without seriously damaging financial position. To be an effective cost control mechanism, a program does not need to undermine hospital financial status. This does not imply, however, that it is necessarily in a program's interest to keep financially shaky hospitals afloat. Nor does the Indiana Program have this policy. Illustrating this point, since the Program's inception in 1960, several Indiana hospitals have ceased to function as acute care institutions, while others have merged to form larger institutions with greater financial stability.

Detailed Findings

Data constraints limited the financial position sample to 125 Segment II hospitals. It is consequently necessary to compare the financial position hospitals with the non-financial position hospitals in Segment II. The same two comparison tests are used for this task as are employed to compare the labor usage and non-labor usage hospitals. As with the latter tests, Appendix B contains the detailed findings of these tests.

Since the financial position sample includes almost 90% of the Segment II sample, it was expected that there would be few differences between the financial position and non-financial position hospitals. This expectation is substantiated by the findings. In Test B there are only four significant differences across the 75 Segment II variables. In Test C there are only three significant differences. The financial position and non-financial position hospitals thus closely resemble each other. The financial position results can consequently be generalized to the Segment II sample, and in turn to the Indiana hospital universe.

The predictive power of the net worth annual analyses is low. As shown in Table 17-4, the R^2 ranges from .16 in the 1973 Michigan equation to .05 in the 1968 Tristate comparison. Collinearity is also low in these equations. The Program's covariance ratio never exceeds .05 and the determinant never falls below .71.

The Program's positive effect in the 1968 Michigan equation is significant at the .05 level, while its influence in the 1973 Michigan comparison is clearly insignificant. In both Combined equations the Program's positive impact is significant only at the .10 level. In contrast, in the Tristate equations its effect is highly insignificant.

Income level has a positive influence on net worth, as does ECF involvement. Physician concentration and emergency/outpatient involvement also have positive effects on net worth but in fewer equations. The other determinants of net worth are nonprofit control and farm population. The

former has a negative influence in the 1973 Michigan equation and the latter a negative impact in the 1968 Tristate equation.

Table 17-4

ANNUAL ANALYSES OF NET WORTH

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	28×10^{2}	21×10^{2}	13×10^{2}	37×10^{2}	19×10^{2}	39×10^{1}
t-value	1.50	1.53	0.58	2.24	0.82	0.24
% impact	10.6	10.5	4.9	19.6	7.1	1.8
covariance	0.04	0.04	0.04	0.05	0.04	0.01
ECF						
coefficient	49×10^{3}	22×10^{3}			48×10^{3}	
t-value	2.97	1.81			2.16	
Emergency/Outpatient						
coefficient			63×10^{3}	63×10^{3}		
t-value			1.87	2.02		
Nonprofit Control						
coefficient			-59×10^{2}			
t-value			-2.31			
MD Concentration						
coefficient	81×10^{0}		11×10^{1}			
t-value	2.44		2.65			
Income						
coefficient	15×10^{-1}	15×10^{-1}			20×10^{-1}	
t-value	1.92	2.77			1.97	
Farm						
coefficient						-19×10^{3}
t-value						-2.21
R^2	0.13	0.08	0.16	0.09	0.07	0.05
Determinant	0.71	0.93	0.78	0.95	0.89	0.99
Constant	44×10^{2}	55×10^{2}	15×10^{3}	14×10^{3}	71×10^{2}	24×10^{3}

The predictive power of the net worth percentage change analyses is distinctly higher than that of the net worth annual analyses. As displayed in Table 17-5, the lowest R^2 is .25 in the Combined equation, with this statistic being highest in the Tristate comparison (.34). Collinearity involving the Indiana Program is low, with the Program's covariance ratio ranging from .04 to .15. Overall collinearity is modest; the determinant falls between .55 and .27.

The Program's negative influence in the Michigan equation is significant at the .01 level. Its effect in the Combined comparison is also

negative but is not significant even at the .10 level. The Program's influence in the Tristate analysis is highly insignificant.

Table 17-5

PERCENTAGE CHANGE ANALYSES OF NET WORTH

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-12×10^{-2}	-38×10^{-2}	55×10^{-3}
t-value	-1.09	-2.40	0.47
% impact	-26.8	-57.0	15.5
covariance	0.04	0.15	0.09
% Δ ECF			
coefficient	57×10^{-2}	45×10^{-2}	
t-value	3.49	1.85	
% Δ MD Concentration			
coefficient	11×10^{-1}		16×10^{-1}
t-value	2.90		4.01
Nonprofit Control			
coefficient	-28×10^{-2}	-45×10^{-2}	-29×10^{-2}
t-value	-2.18	-2.53	-2.11
MD Concentration			
coefficient	44×10^{-4}	13×10^{-3}	81×10^{-4}
t-value	1.79	3.67	3.08
Income			
coefficient			20×10^{-5}
t-value			3.15
Farm			
coefficient	19×10^{-1}	34×10^{-1}	45×10^{-1}
t-value	2.63	2.75	4.63
R^2	0.25	0.28	0.34
Determinant	0.55	0.39	0.27
Constant	11×10^{-2}	-30×10^{-2}	-26×10^{-1}

Three factors are significant determinants of this endogenous variable in all equations: farm population, physician concentration, and nonprofit control. The former two variables have positive effects and the latter has a negative influence. The percentage change in ECF involvement has a positive influence in the Combined and Michigan equations, and the percentage change in physician concentration has a positive impact in the Combined and Tristate equations. The remaining determinant in these equations, income level, has a positive impact in the Tristate equation.

The predictive power of the working capital annual analyses is very low. The R^2 ranges from .18 to .00, as indicated in Table 17-6.

Collinearity is low in these equations especially in terms of the Indiana Program. Its covariance ratio is never higher than .12; the determinant is never below .42.

Table 17-6

ANNUAL ANALYSES OF WORKING CAPITAL

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-92×10^{1}	41×10^{1}	-17×10^{2}	10×10^{1}	-15×10^{2}	64×10^{1}
t-value	-1.10	0.76	-1.49	0.14	-1.50	1.08
% impact	-11.3	7.2	-19.5	1.7	-17.1	11.6
covariance	0.03	0.00	0.12	0.00	0.07	0.00
Elderly Caseload						
coefficient	11×10^{3}				13×10^{3}	
t-value	1.84				1.69	
Nonprofit Control						
coefficient	-18×10^{2}		-22×10^{2}		-29×10^{2}	
t-value	-2.12		-1.80		-2.73	
MD Concentration						
coefficient			73×10^{0}			
t-value			3.29			
Income						
coefficient	14×10^{-1}				18×10^{-1}	
t-value	3.26				3.39	
Farm						
coefficient			16×10^{3}			
t-value			1.85			
$\bar{R}^2$	0.10	0.00	0.15	0.00	0.18	0.01
Determinant	0.47	1.00	0.46	1.00	0.42	1.00
Constant	-90×10^{2}	58×10^{2}	33×10^{2}	61×10^{2}	-13×10^{3}	55×10^{2}

In the 1973 Michigan and Tristate equations the influence of the Program is negative but significant only at the .10 level. It is also negative in the 1973 Combined equation, but it is not significant even at the .10 level. In the 1968 analyses the Program's influence is positive and insignificant.

In the 1968 equations there are no significant determinants of working capital. Nonprofit control has a negative influence in all three 1973 equations. Income level and elderly caseload have positive effects in the 1973 Combined and Tristate equations. In the 1973 Michigan comparison physician concentration and farm population have positive effects.

As with the annual analyses, the predictive power of the working capital percentage change analyses is very low, with the R^2s ranging from .05 to .00. As shown in Table 17-7, the Michigan and Tristate equations contain no significant determinants. Consequently, collinearity is nonexistent in these equations. Collinearity is also low in the Combined comparison, which has two significant determinants: percentage change in physician concentration and nonprofit control. The former has a positive influence and the latter a negative effect. The Program's influence is thoroughly insignificant in all three equations.

Table 17-7

PERCENTAGE CHANGE ANALYSES OF WORKING CAPITAL

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-15×10^{-2}	43×10^{-3}	-20×10^{-2}
t-value	-0.64	0.15	-0.71
% impact	-22.9	8.7	-27.1
covariance	0.03	0.00	0.00
% Δ MD Concentration			
coefficient	14×10^{-1}		
t-value	1.84		
Nonprofit Control			
coefficient	-39×10^{-2}		
t-value	-1.69		
R^2	0.05	0.00	0.01
Determinant	0.96	1.00	1.00
Constant	88×10^{-2}	50×10^{-2}	74×10^{-2}

The predictive power of the profit margin annual analyses is distinctly higher than that of the other financial position annual analyses. As shown in Table 17-8, this is especially true in the 1973 equations in which the R^2 ranges from .36 to .26. Collinearity is low in all these equations. The Program's covariance ratio never exceeds .06 and the determinant never falls below .55.

Consistent with the percentage impact results, the Program's influence is significant at the .001 level in the 1973 Combined equation, at the .01 level in the 1973 Tristate comparison, and at the .05 level in the 1973 Michigan equation. In the 1968 Tristate equation the Program's effect is negative and almost significant at the .05 level. It is also negative in the remaining two 1968 equations, but is not significant even at the .10 level.

Table 17-8

ANNUAL ANALYSES OF PROFIT MARGIN

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-30×10^{-3}	-80×10^{-4}	-22×10^{-3}	-13×10^{-3}	-31×10^{-3}	-23×10^{-3}
t-value	-3.22	-0.66	-2.18	-1.02	-2.70	-1.57
% impact	-190.3	-3330.7	-123.2	-369.9	-177.0	-364.4
covariance	0.04	0.04	0.06	0.00	0.01	0.04
ECF						
coefficient	-15×10^{-2}					
t-value	-1.88					
Elderly Caseload						
coefficient		-24×10^{-2}			-35×10^{-2}	-42×10^{-2}
t-value		-3.15			-5.17	-4.40
Fiscal Year						
coefficient						-52×10^{-4}
t-value						-1.97
Nonprofit Control						
coefficient		24×10^{-3}				
t-value		1.92				
Income						
coefficient		-14×10^{-6}				-19×10^{-6}
t-value		-2.47				-2.53
Farm						
coefficient	-24×10^{-2}		-35×10^{-2}			
t-value	-4.73		-5.44			
R^2	0.26	0.12	0.36	0.01	0.26	0.20
Determinant	0.91	0.55	0.94	1.00	0.99	0.60
Constant	92×10^{-4}	21×10^{-2}	10×10^{-3}	36×10^{-4}	12×10^{0}	39×10^{-2}

Farm population has a strong negative influence on profit margin in the 1973 Combined and Michigan equations. The same is true for elderly caseload in the Tristate comparisons and the 1968 Combined equation. Other significant determinants are income level, ECF involvement, fiscal year, and nonprofit control. The first three variables have negative effects and the last variable has a positive influence.

The predictive power of the profit margin percentage change analyses is higher than that of the working capital percentage change analyses, but lower than that of the net worth percentage change analyses. As indicated in Table 17-9, the R^2 falls between .24 and .13. Collinearity is modest in these equations, with the Program's covariance ratio and the determinant ranging respectively from .03 to .26 and from .83 to .58.

Table 17-9

PERCENTAGE CHANGE ANALYSES OF PROFIT MARGIN

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-10×10^{-1}	-32×10^{-2}	-13×10^{-1}
t-value	-2.04	-0.44	-2.24
% impact	-168.1	-33.7	-273.9
covariance	0.03	0.26	0.07
% Δ ECF			
coefficient	-14×10^{-1}	-18×10^{-1}	
t-value	-1.90	-1.68	
Fiscal Year			
coefficient		26×10^{-2}	
t-value		1.98	
Nonprofit Control			
coefficient	-16×10^{-1}	-6×10^{-1}	-20×10^{-1}
t-value	-2.99	-2.39	-3.11
Income			
coefficient	49×10^{-5}	93×10^{-5}	
t-value	2.43	3.12	
Farm			
coefficient			-81×10^{-1}
t-value			-2.35
R^2	0.14	0.24	0.13
Determinant	0.83	0.58	0.72
Constant	-44×10^{-1}	-11×10^{0}	16×10^{-1}

The Program's effects in the Tristate and Combined equations are significant at the .05 level. The Program's impact in the Michigan comparison is also negative, but is highly insignificant.

As in the percentage change net worth analyses, nonprofit control exerts a negative influence on the percentage change in profit margin in all three equations. In contrast to the percentage change net worth analyses, but consistent with the profit margin annual analyses, the percentage change in ECF involvement also has a negative impact. Income level has a positive effect in the Combined and Michigan equations and farm population has a negative influence in the Tristate comparison. In addition, fiscal year has a positive influence in the Michigan equation.

Shared/Contracted Services

Overall Results

Findings -- It was expected that the Program would have a modest positive impact on shared/contracted services in 1973, and a weaker positive or insignificant influence on this variable in 1968. Accordingly, it was anticipated that the Program would have a positive effect on the percentage change in shared/contracted services.

The findings do not substantiate these hypotheses. As shown in Table 17-10, in the Combined analyses the Program has an insignificant influence on shared/contracted services in both 1973 and 1968. Its impact on the percentage change in this variable is significant, but is negative rather than positive, equalling -72%. As with many of the Program's effects on percentage change variables, its influence in this instance is less dominant in absolute terms than in relative terms. The Program decreases the percentage change in shared/contracted services by an absolute amount of 18%.

Table 17-10

IMPACT OF INDIANA PROGRAM ON
SHARED/CONTRACTED SERVICES

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1968	0	0	0
% Δ	-72%	-67%	-75%

The Michigan and Tristate findings closely resemble the Combined results. In these analyses the Program's influence is insignificant in the two study years. Its impact on the percentage change in shared/contracted services is -75% and -67% respectively in the Tristate and Michigan analyses.

Since the Program has a negative influence on the percentage change in shared/contracted services, it is important to determine whether the Program impacts the percentage change in cost through this variable. Accordingly, the effect of the percentage change in sharing/contracting on the percentage change in cost was assessed in Step C total cost analyses. This effect is insignificant in these analyses. The Program thus does not influence the percentage change in cost by

impacting the percentage change in sharing/contracting. The Step C analyses also indicate that sharing/contracting does not have a negative effect on total cost in either 1973 or 1968.

Interpretation -- In general, the Indiana Program has an insubstantial influence on shared/contracted services. In particular, it has an insignificant impact on this variable in 1973 and 1968. It does have a significant effect on the percentage change in this variable, but its influence is negative, not positive. While the rationale for this effect is uncertain, it is nonetheless clear that the Indiana Program does not lower cost by increasing sharing/contracting.

Although sharing/contracting is often trumpeted as a cost control device, these analyses make it evident that prospective rate setting can substantially lower cost without impacting sharing/contracting. Further, they show that sharing/contracting does not have a negative effect on cost. However, it was a relatively uncommon activity among study hospitals, and in terms of the variable itself, was limited to the areas of laundry, dietary, and purchasing. It is therefore possible that a prospective rate setting program could achieve substantial cost reductions by encouraging sharing/contracting, but this study does not provide evidence to support this thesis.

Detailed Findings

The predictive power of the shared/contracted services annual analyses is distinctly higher in the Tristate equations than in the Combined or Michigan comparisons. As indicated in Table 17-11, the R^2s approximate .25 in the Tristate analyses and .08 in the latter comparisons. In all analyses, collinearity involving the Indiana Program is low, with its covariance ratio never exceeding .06. Overall collinearity is higher in the Tristate comparisons than in the Combined or Michigan equations, which reflects the greater number of determinants in the former.

In the 1968 comparisons the influence of the Indiana Program is positive. It is almost significant at the .10 level in the Combined and Michigan equations; it is clearly insignificant in the Tristate analysis. In contrast, the Program's effect is negative in all 1973 equations. In the Tristate and Combined analyses its impact is significant at the .10 level and is almost significant at the .05 level, especially in the Tristate equation. In the Michigan comparison the Program's effect is insignificant even at the .10 level. The Program's impact thus shifts from positive albeit insignificant in 1968 to negative but insignificant in 1973. These findings corroborate the Program's negative influence in the percentage change analyses. This is an important result since for the reasons discussed earlier the annual analyses are given precedence in this study.

Church control has a positive impact on shared/contracted services in the 1973 equations, although not in the 1968 analyses. However,

nonprofit control has a positive effect in the 1968 Combined and Michigan equations. In all but these two equations income level has a positive influence. Bed size has a strong negative impact in the Tristate analyses as does white population. The remaining determinant is medical education involvement, which has a positive effect in the Tristate equations.

Table 17-11

ANNUAL ANALYSES OF SHARED/CONTRACTED SERVICES

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-38×10^{-2}	24×10^{-2}	-34×10^{-2}	33×10^{-2}	-43×10^{-2}	83×10^{-3}
t-value	-1.49	1.20	-1.06	1.28	-1.61	0.40
% impact	-8.4	6.7	-7.7	9.4	-9.4	2.2
covariance	0.01	0.02	0.06	0.01	0.02	0.01
Bed Size						
coefficient					-63×10^{-4}	-43×10^{-4}
t-value					-4.63	-4.03
Medical Education						
coefficient					18×10^{0}	19×10^{0}
t-value					1.86	1.72
Nonprofit Control						
coefficient		36×10^{-2}		51×10^{-2}		
t-value		1.76		1.99		
Church Control						
coefficient	70×10^{-2}		11×10^{-1}		86×10^{-2}	
t-value	2.26		2.69		2.37	
Income						
coefficient	23×10^{-5}		25×10^{-5}		37×10^{-5}	22×10^{-5}
t-value	2.35		1.97		2.90	2.18
White						
coefficient					-12×10^{0}	-11×10^{0}
t-value					-3.28	-4.17
R^2	0.09	0.03	0.13	0.05	0.28	0.22
Determinant	0.98	0.98	0.93	0.99	0.18	0.29
Constant	21×10^{-1}	34×10^{-1}	17×10^{-1}	32×10^{-1}	13×10^{0}	13×10^{0}

The predictive power of the shared/contracted services percentage change analyses is approximately the same as that of the annual analyses of this variable. The R^2s approximate .15, as shown in Table 17-12. Collinearity is extremely low in these equations. The Program's covariance ratio ranges from .00 to .07, and the determinant from 1.0 to .93.

Table 17-12

PERCENTAGE CHANGE ANALYSES OF
SHARED/CONTRACTED SERVICES

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-18×10^{-2}	-16×10^{-2}	-19×10^{-2}
t-value	-3.19	-2.61	-3.16
% impact	-72.1	-67.4	-74.8
covariance	0.02	0.07	0.00
Medical Education			
coefficient	35×10^{-1}	33×10^{-1}	
t-value	2.46	2.54	
Church Control			
coefficient	11×10^{-2}		14×10^{-2}
t-value	1.75		2.03
R^2	0.14	0.16	0.13
Determinant	0.97	0.93	1.00
Constant	20×10^{-2}	21×10^{-2}	22×10^{-2}

The Indiana Program's impact is narrowly significant at the .001 level in the Combined and Tristate equations. It is significant at the .01 level in the Michigan analysis. Aside from the Indiana Program, there are only two significant determinants in these equations. Medical education involvement has a positive impact in the Combined and Michigan comparisons, while church control has a positive influence in the Tristate and Combined equations.

VI.

Segment III: Influence on Quality and Case Intensity

The root issue addressed by this segment is: Does the Program influence the effectiveness of hospital care? That is, does it change the nature of hospital output? Is the quality of care in Indiana hospitals different from that in control hospitals? Do these two sets of hospitals treat dissimilar cases? Do they offer dissimilar services?

If the answer to any of these questions is yes, a significant side effect is present which may be partially responsible for the Program's negative impact on hospital cost. Even more important, independent of whether the side effect serves as a pathway for the Program's cost influence, it may be sufficiently serious by itself to override the benefits of the Program's cost savings.

This segment is thus directed primarily toward the third study objective, but its findings are also germane to the second objective. All Segment III results are derived from regression analysis. The central data source in this segment is the computerized data of the Commission on Professional and Hospital Activities (CPHA). The study case base was drawn from this source and was used to construct most of the variables analyzed in this segment.

Because all study hospitals are not CPHA subscribers, the Segment III sample is composed of about 40% of the study hospitals. The characteristics of Segment III and non-Segment III hospitals are not as similar as those of Segment II and non-Segment II hospitals. Even so, the resemblance is sufficient to allow generalization of the main Segment III findings to the Indiana hospital universe.

Because of the characteristics of its main data source, the time period for this segment is 1970 through 1973. The four chapters of this section are similar in nature to those of Sections IV and V.

18.
Expected Impact of the Program

Most Segment III endogenous variables are dominated by physician influence. This fact has two important implications. First, it makes it unlikely that the Indiana Program exerts a significant influence on these variables since physicians are distant from the Program. The Segment I and II results are strongly consistent with the general thesis that the Program primarily impacts hospitals through the administrative staff rather than through the physician staff. This thesis is therefore invoked throughout this chapter. Nevertheless, it remains possible that the Program also affects physicians, and this segment represents a definitive test of this possibility.

The second implication is that it is substantively unsound to use all three control groups for these analyses. A common finding of Segments I and II is that the Michigan Blue Cross planning program has little effect. If this program exerts little influence on those variables which are administrator-controlled, there is no logic for expecting it to impact physician-dominated variables. In most Segment III analyses, there is thus no substantive rationale for expecting a difference between the Michigan and Tristate findings. Consequently, in most of this segment only the Combined findings are examined.

There are two exceptions to this general approach. One is the service mix analyses where all three control groups are used. The reason is twofold: First, service mix is less physician-dominated than are the other Segment III variables; and second, service mix is at times an explicit target of planning programs. The other exception is a special set of analyses involving the Michigan control group. Their purpose is to explicitly test the thesis that the Michigan planning program does not have a significant influence on physician-dominated variables.

The organization of this chapter is analogous to that of Chapters 10 and 14. The hypotheses are specified in terms of 1973, 1970, and the percentage change between these years. As before, they should be interpreted in a multivariate context and as indicating expected statistical significance at least at the .05 level.

Case Intensity

Definition

Case intensity is the composition of hospital patients in terms of medical or surgical conditions, i.e., the mixture of illnesses/injuries treated by the hospital. Within this area, the case mix variable

characterizes the intensity of hospital caseload in terms of the mixture of diagnosis or operation groups (e.g., influenza, normal delivery, or appendectomy). Intensity is defined in this index as the expected costliness per case for each diagnosis/operation group. For example, treatment of a fractured hip is usually much more expensive than extraction of a tooth. Therefore, if a hospital treats a relatively high proportion of fractured hips and a relatively low proportion of tooth extractions, its value for the case mix index will be higher.

The case severity index is substantively similar to the case mix index, but different structurally. It depicts the expected costliness of hospital caseload within (not across) specified diagnosis or operation groups. Case severity is a necessary index since there may be substantial differences among hospitals in terms of the costliness of cases treated within certain diagnosis/operation groups. Such differences cannot be detected by the case mix index alone. These two indices are thus close complements, each representing a different aspect of case intensity.

Case severity is designed to encompass both the inherent seriousness of the case and the predominant nature of the services provided for the case. As an example of the first characteristic, consider intracranial injury. In one instance a patient may have sustained a serious head injury requiring complex and urgent care; in another instance a patient may have suffered only a moderate concussion and been admitted for overnight observation with little care required. The seriousness of these two cases is sharply divergent; yet they have the same diagnosis and will consequently be weighted identically in the case mix index. Their implications for hospital cost are distinctly different, however, creating the need for the case severity index.

The same phenomenon arises because of the second characteristic represented by this index -- the dominant nature of the services rendered. To illustrate this aspect of the index, consider benign hypertension. A hypertensive patient in fair control may be admitted for a thorough evaluation involving study of a number of organ systems; in another instance a similar hypertensive patient may be admitted for a much more limited investigation directed toward improved maintenance therapy. In this example it is not simply a question of a few additional tests. Rather, the entire purpose of the admission is different. Hence, the two cases have sharply divergent cost implications.

The remaining case intensity variable is the elective surgery index, which indicates the prevalence of elective surgery in the hospital's caseload. In this index elective surgery is defined as operations which can generally be scheduled in advance and which are usually performed on people who are well except for the problem addressed by the operation. Examples are hernia repair, hysterectomy, and tonsillectomy.

Importance

Case mix and case severity are basic indicators of the nature of hospital output. In general, the higher these indices, the higher will be hospital cost. It is therefore essential to determine whether the Indiana Program has significantly influenced these factors. That is, does the Program partially reduce cost by decreasing case mix and case severity? Such an effect may not be desirable since it may mean that relatively well patients are being inappropriately hospitalized. Conversely, the Indiana Program may increase case mix and case severity, thereby offsetting its negative effect on cost.

The negotiating unit in the Indiana Program is the total hospital budget. However, the payment units are charges for different services which include a single charge for the daily occupancy of a hospital bed. As in hospitals elsewhere, this bed or room charge is intended to cover most nursing, hotel, and administrative services. In contrast, separate charges are imposed for different ancillary services, with the charge usually being higher than the marginal cost of the service.

Under this set of incentives an Indiana hospital could improve its financial position in the short run by increasing the proportion of its patients who require a high intensity of ancillary services but a low intensity of nursing services. If a hospital achieves this result without lowering its overall occupancy, its nursing cost will fall to a greater extent than its nursing revenue, since most of the latter is derived from the room charge. At the same time the profitability of its ancillary services will rise since the marginal revenue from the additional services will exceed the marginal cost.

In the long run this stratagem will be less profitable since at least some of its effects will be recognized (even if not explicitly) and taken into account during the review of the hospital's next rate request. But in the short run, this tactic could substantially ease a hospital's financial strain. Even in the long run it might make it easier for a hospital to operate under the Program.

Among other types of hospital patients, elective surgery cases often require a high intensity of ancillary care and a moderate or low intensity of nursing care. Most such patients are relatively well at the time of admission, and in most instances the procedure itself is not so debilitating as to require extensive nursing care during the recuperative period. Yet these patients require such ancillary services as operating room, anesthesia, recovery room, and intravenous therapy. Most also receive laboratory and radiology services. In addition, length of stay is often short, further increasing average ancillary intensity per day.

Not only do elective surgery patients generally fall into the high ancillary, low nursing intensity category, but they are an easily

definable group. Elective surgery is not so amorphous that it would be impossible for a hospital administrator to encourage physicians to increase their elective surgery work. To illustrate this point, contrast the ready identifiability of elective surgery with the difficulty of establishing guidelines for distinguishing between high and low nursing intensity pneumonia patients. Hence, examination of elective surgery provides an excellent test of the possibility that the incentives of the Indiana Program may induce hospitals to shift toward high ancillary, low nursing intensity care.

Such a test is important for two reasons. First, it may pinpoint an important deficiency if it reveals that the Indiana Program induces inappropriate concentration on elective surgery, which could be indicative of unnecessary surgery and/or limited hospital access for certain other types of patients. The importance of examining this possibility is heightened by the earlier finding that the Program has a stronger effect on nursing cost than on the other departmental costs.

Second, this test is a more sensitive indicator of the Program's impact on case intensity than are the case mix or case severity analyses. If despite the specific incentive patterns and the manipulable nature of elective surgery the Program does not stimulate hospital administrators to encourage physicians to modify their admission and treatment practices, it is unlikely that the Program has any impact on case intensity (even in ways not specifically measured in this study).

Effects of Indiana Program

Case mix and case severity are primarily determined by physicians, who decide which cases to admit, what services to provide, and how long the cases should remain hospitalized. As emphasized earlier, the Indiana Program has little apparent effect on physicians. It is consequently unlikely that the Program has a significant influence on either case mix or case severity. This hypothesis will be extended to elective surgery, even though it is the case intensity variable most likely to be affected by the Program.

In summary, the following hypotheses will be tested in this area.

(1) The Indiana Program will have an insignificant influence on case mix in 1973 and 1970, and on the percentage change in this variable.

(2) The Indiana Program will have an insignificant effect on case severity in 1973 and 1970, and on the percentage change in this variable.

(3) The Indiana Program will have an insignificant impact on elective surgery in 1973 and 1970, and on the percentage change in this variable.

Utilization Practices

Definition

Two major determinants of length of stay are case mix and case severity. The higher these variables, the longer will be length of stay. However, length of stay is also influenced by another factor -- utilization practices, which is defined as the customary length of stay prescribed by physicians for similar cases.

For example, prevailing physician practice in one hospital may be to prescribe a length of stay of five days for hernia repair. In another hospital, customary physician practice may be to advise a length of stay of seven days for the same condition, despite the equal severity of hernia cases in the two hospitals. Thus, even if case mix and case severity are identical in these hospitals, length of stay will be longer in the second institution because of the difference in utilization practices.

Importance

Utilization practices is largely determined by dominant physicians in an area and by major medical education programs serving the area. Accordingly, there are wider differences in utilization practices among major regions of the country than among states in the same region -- one of the reasons for requiring that all control states be located in the Midwest. Although it is thus unlikely that there are major differences in utilization practices in this study, its geographic scope is still sufficient to permit some differences. Consequently, it is important to determine whether the Program has a significant influence on utilization practices, since such an influence could affect the Program's impact on both length of stay and total cost.

Effects of Indiana Program

Although utilization practices can be influenced by the administrative staff, by definition it is primarily determined by physicians. It is therefore unlikely that this variable is significantly affected by the Indiana Program.

As discussed earlier, the common thrust of the Segment I and II findings is that the Michigan planning system has little effect. However, the system does have a negative impact on the percentage change in bed size. It is consequently possible that the Michigan program constricts bed supply in that state. If this constriction is of sufficient magnitude, it could produce an increase in case mix and case severity and a decrease in utilization practices.

This possibility will be tested in special analyses comparing Indiana and Michigan hospitals. If the above effects hold, the Indiana Program would have a negative impact on case mix and case severity and a positive influence on utilization practices. While such effects are possible, they are unlikely. Given the weakness of the Michigan program's

influence in the Segment I and II findings, it is improbable that this program has sufficiently restricted bed supply to induce a change in the physician-dominated variables of case mix, case severity, and utilization practices.

This test is important because it examines a thesis central to the design of Segment III. If as expected the Indiana Program (and thus the Michigan program) has an insignificant influence in these analyses, the analytical framework of Segment III will be substantiated. Conversely, if the above-described effects do materialize, it may be necessary to conduct additional analyses examining the effect of the Michigan program on other physician-dominated variables.

In summary, the following hypotheses will be tested in this area.

(4) The Indiana Program will have an insignificant influence on utilization practices in 1973 and 1970, and on the percentage change in this variable.

(5) In special Michigan analyses the Indiana Program will have insignificant effects on case mix, case severity, and utilization practices in 1973 and 1970, and on the percentage changes in these variables.

Patient Mix

Definition

Patient mix is the composition of hospital caseload in terms of patient characteristics, rather than diagnosis/operation groups. Two major patient characteristics are age and race. From a hospital perspective the most significant age distinction is that between the elderly and the remainder of the population. This distinction is represented by elderly caseload, which is considered a semi-exogenous variable in Segments I and II. The most important racial difference in the five Midwestern study states is that between whites and blacks. This difference is depicted by white caseload, which is analogous to elderly caseload.

Importance

An impact of the Indiana Program on elderly caseload and/or white caseload is important from two viewpoints. First, it could indicate another pathway for the Program's impact on cost since both elderly caseload and white caseload are likely to influence length of stay, and by extension, total cost (albeit to a lesser extent). Second, it could signal a misplaced emphasis on care of whites and/or the aged. That is, it could suggest that the Indiana Program induces hospitals to inappropriately discriminate among their patients on the basis of age and/or race.

These analyses are important in another way. Elderly caseload is considered a Type B semi-exogenous variable in Segments I and II primarily because of the expectation that the Indiana Program does not have a significant influence on this variable. These analyses specifically test this expectation, and thus substantiate or weaken the analytical framework of the earlier segments.

Effects of Indiana Program

The age composition of hospital caseload can be influenced by the administrative staff. For example, hospital administrators can encourage the admission and/or continued stay of elderly patients for subacute or even convalescent care. Nonetheless, except for specialty hospitals (none of which are included in this study), the physician primarily determines the age mixture of hospital patients.

Similarly, the physician staff has a greater influence on the racial composition of hospital caseload than does the administrative staff. An important factor in this regard is that in order to discriminate on the basis of race the administrative staff must rely on explicit, organized efforts -- precisely those types of activities expressly prohibited by civil rights laws.

Thus, like case intensity and utilization practices, since physicians primarily control patient mix and since physicians are little influenced by the Indiana Program, it is unlikely that the Program has a significant impact on either elderly caseload or white caseload.

In summary, the following hypotheses will be tested in this area.

(6) The Indiana Program will have an insignificant impact on elderly caseload in 1973 and 1970, and on the percentage change in this variable.

(7) The Indiana Program will have an insignificant influence on white caseload in 1973 and 1970, and on the percentage change in this variable.

Length of Stay

Definition

Length of stay is a basic hospital utilization measure which has been employed for many years by hospital administrators, analysts, and physicians. It is defined in the customary way as patient days divided by cases.

Importance

The Segment III variables discussed earlier characterize specific dimensions of hospital caseload. In contrast, length of stay is an aggregate variable reflecting a number of influences. It is thus a less precise indicator than the other variables. A possible effect of

the Indiana Program on length of stay may or may not be desirable. In order to evaluate such an effect, it is necessary to determine why the Program influences length of stay. For example, the implications are substantially different if length of stay is lower because of reduced case mix or because of decreased elderly caseload.

From this standpoint the length of stay analyses are less important than the Segment III analyses described earlier. From another viewpoint the length of stay analyses are central to the study methodology. Length of stay is treated as a Type B semi-exogenous variable in the earlier segments. Unlike elderly caseload, it has a major impact on total cost as well as on other endogenous variables. It is consequently mandatory to test the validity of the thesis responsible for the classification of length of stay as a semi-exogenous variable -- the low likelihood that the Program influences length of stay. If the results corroborate this thesis, no further steps are required. If they do not, it will be necessary to identify the variables through which the Program influences length of stay, since the substantive implications vary with the transmitting variables.

Effects of Indiana Program

Length of stay is likely to be primarily determined by case intensity, utilization practices, and patient mix, with the first factor having the strongest influence. Since these variables are physician-dominated, length of stay is also physician-dominated. It is therefore unlikely that the Indiana Program has a significant influence on length of stay.

In summary, the following hypothesis will be tested in this area.

(8) The Indiana Program will have an insignificant impact on length of stay in 1973 and 1970, and on the percentage change in this variable.

Quality

Definition

The quality of hospital care is based on the effectiveness of such care. That is, if the quality of care is higher, the presumption is that the care is more effective. Accordingly, it is the intent of all quality measures to represent in some way the effectiveness of care.

The quality index of this study conforms to this principle. It is a process quality variable, which means that its objective is to indicate whether patient management is in accord with accepted medical practice. It aggregates each hospital's performance on a number of individual process quality measures. Examples of such measures are the percentage of acute myocardial infarction patients with electronic monitoring; the proportion of adult pneumonia patients with a chest x-ray; the

percentage of appendectomy patients with a rectal or pelvic exam; and the percentage of fractured hip patients with an electrocardiogram.

In each example it is accepted medical practice to prescribe the indicated diagnostic or therapeutic procedure. That is, it is generally agreed by physicians and others in medicine that the quality of care is higher if these procedures are used to treat these conditions. Correspondingly, the quality index will be relatively high for institutions where these procedures are a customary part of the management plan for these patients. Conversely, if these procedures are infrequently administered in a hospital, the quality index will be relatively low for that hospital.

Since it is a process quality variable, the quality index is dependent on the existing state of medical knowledge. It is entirely possible that an individual process measure has little causal relationship with the effectiveness of hospital care. For example, it may be demonstrated in the future that a chest x-ray is not an efficacious component of the treatment of pneumonia. It is thus possible that the quality index is not a solid indicator of the effectiveness of hospital care. However, it is based directly on medical standards prevailing during the study period and is therefore an indicator of hospital quality in terms of such standards. Even if certain standards are partially disproven during the next quarter century, they were nonetheless widely accepted during the study years.

Importance

Quality is almost as important as cost to a prospective rate setting program. While the main objective of such programs is the restraint of cost, it would be a grievous side effect if a program reduced quality. In all likelihood such a result would be politically unacceptable; it might also be unacceptable from a cost effectiveness viewpoint.

Placing this issue in the context of this study, the question is: Does the Indiana Program achieve its cost-reducing effect without lowering the quality of care? Or is its negative impact on cost purchased in part through a negative effect on quality? Or has the Program conceivably induced an increase in quality while constraining cost?

Effects of Indiana Program

Quality is heavily dominated by physicians. Through education programs, administrative actions, and other steps, the administrative staff can influence to some extent the nature of patient management. It can also expand or constrict the availability of certain diagnostic tests and therapeutic procedures. However, the physician makes the final

patient management decisions. Because of this physician dominance it is unlikely that the Indiana Program has a significant effect on quality.[1]

In summary, the following hypothesis will be tested in this area.

(9) The Indiana Program will have an insignificant influence on quality in 1973 and 1970, and on the percentage change in this variable.

Service Mix

Definition

Two types of service mix are examined in this project. One is specialized service mix, i.e., the array of sophisticated and costly services offered by the hospital. Examples of such services are open heart surgery, renal dialysis, and x-ray therapy. Only a few hospitals would be expected to have all the specialized services; many hospitals would not be expected to have any of these services.

In contrast, basic service mix focuses on those services which almost all hospitals should have. Although there are occasional justifiable exceptions, the great majority of hospitals should have all the basic services in order to function effectively as acute care institutions. Examples of such services are physical therapy, histopathology laboratory, and pharmacy department headed by a full-time pharmacist.

Importance

Both types of service mix are important, but for different reasons. Basic service mix is not likely to have a major effect on cost and is thus not likely to be a variable transmitting the Program's influence on cost. However, this variable is in part a quality measure since it would not be desirable for a prospective rate setting program to force hospitals to cut services essential to their functioning. Accordingly, the purpose of the basic service mix analyses is to determine whether the Indiana Program has this undesirable effect.

It is essential for some hospitals to provide specialized services, but it may be too costly if many hospitals offer such services.

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[1] Citing a rationale similar to that for elective surgery, it could be argued that the Indiana Program induces an increase in the quality index because many of the individual process measures focus on the provision of ancillary services. However, such an effect is unlikely since the process measures emphasize those cases where the use of a specific ancillary service is considered mandatory rather than discretionary.

Unlike basic service mix, the substantive implications are thus uncertain if the Indiana Program reduces specialized service mix. However, since this variable is likely to have a stronger impact on cost than does basic service mix, the specialized service mix analyses may identify another mechanism through which the Program affects cost.

Effects of Indiana Program

Service mix is more jointly controlled by the administrative and physician staffs than are the other Segment III variables. Physicians have a major voice in deciding which services the hospital should secure, but the acquisition of services is also carefully reviewed by the administrative staff as well as by the board of trustees if such acquisition is of sufficient magnitude.

For this reason alone it is more likely that the Indiana Program has a significant effect on service mix than on the other Segment III variables. Nonetheless, such an effect is still improbable. Aside from its capital expenditures review, the Program has not attempted to reduce service mix. In fact, it has generally encouraged Indiana hospitals to become and remain full-service institutions.

In the Segment I and II results the Program has few effects on capital usage. Its influence on financial position is similarly modest, providing no evidence that financial pressure is severe enough to induce hospitals to engage in wholesale cutting of services. Thus, both the earlier results and substantive considerations support the likelihood that the Program has an insignificant influence on service mix.

Control of service mix is at times an objective of planning programs. However, during the study years the Michigan program concentrated more on slowing bed growth than on changing service mix. It is therefore unlikely that the Michigan program has a significant effect on service mix, but the possibility of such an effect is greater for service mix than for the other Segment III variables. Hence, the Michigan and Tristate comparisons as well as the Combined comparisons are included in the service mix analyses.

In summary, the following hypotheses will be tested in this area.

(10) The Indiana Program will have an insignificant influence on specialized service mix in 1973 and 1970, and on the percentage change in this variable.

(11) The Indiana Program will have an insignificant impact on basic service mix in 1973 and 1970, and on the percentage change in this variable.

(12) These findings will apply to the Michigan and Tristate analyses as well as to the Combined analyses.

19.
Endogenous Variables

The main data source for the Segment III variables is the data base of the Commission on Professional and Hospital Activities (CPHA), which is used for the case intensity, quality, utilization practices, and white caseload variables. The AHA Survey is the source for the two service mix variables. The other endogenous variables, length of stay and elderly caseload, were considered semi-exogenous factors in Segments I and II. They are drawn from Medicare Cost Report data.

The first chapter topic is the case intensity and utilization practices variables, which are considered together because the case severity and utilization practices indices are constructed similarly. The next subject is the patient mix and length of stay measures. The last two topics are the quality index and the service mix variables. As with the Segment I and II endogenous variables, the means and standard deviations of all these variables are displayed in Appendix B.

Case Intensity and Utilization Practices

The first step in the construction of the CPHA variables was the specification of cohorts to be included in the study case base. Since CPHA employs the Hospital Adaptation of the International Classification of Diseases (H-ICDA) to classify cases, H-ICDA diagnosis and operation codes are used to define the case cohorts in this study. It was thus possible to use four-digit and three-digit diagnosis codes and three-digit operation codes in this project. This is a great advantage since such codes are more specific and delineate more homogeneous cases than do broader groupings, such as the 17 major H-ICDA categories. For example, diseases of the genitourinary system, a major H-ICDA category, includes such diverse conditions as acute pyelonephritis, calculus of kidney/ureter, hyperplasia of prostate, uterovaginal prolapse, and disorders of menstruation.

The case mix and other CPHA indices used in this project are thus based on more clearly defined cohorts than are the case mix indices employed in most earlier studies.[1] This characteristic markedly strengthens their substantive and statistical soundness.

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[1] Examples of studies using broad and heterogeneous cohorts are Feldstein (1967); Lave, Lave, and Silverman (1972); Lee and Wallace (1973); Bays (1977); and Thornberry and Zimmerman (1976). Studies using more specific and homogeneous cohorts are Lave and Leinhardt (1976); Feldstein and Schuttinga (1977); Thompson, Fetter, and Mross (1975); and Rafferty (1971 and 1972).

Three main criteria were used to define the cohorts for this study. First, each cohort had to be relatively homogeneous in the sense of consisting of similar cases. However, in order to avoid unduly limiting the size of the study case base, strict homogeneity was not required for every cohort. The second criterion is that each cohort had to be relatively common, although there are a few exceptions where a cohort is both homogeneous and closely related to more frequent cohorts. Third, the cohorts as a whole had to be conducive to the development of the indices to be constructed from the CPHA data. For example, since a quality index was to be developed from this data, it was essential that it be possible to construct meaningful quality measures for at least some cohorts.

Using these three criteria, 45 cohorts -- 28 diagnosis groups and 17 operation groups -- were selected for inclusion in the study case base, which is accordingly defined as the total number of cases in these cohorts in all study hospitals. In both study years these cohorts encompass approximately 53% of the average study hospital's caseload. Table 19-1 indicates both the H-ICDA codes which define these cohorts and the percentage of the study case base represented by each cohort.

While the study case base does not include the entirety of hospital caseload, it is likely for two reasons that it is highly representative of total hospital caseload. First, it includes approximately 50% of hospital cases. Second, as is evident in Table 19-1, it encompasses a wide diversity of cohorts ranging across the spectrum of cases treated by hospitals.

Table 19-1

DEFINITION AND FREQUENCY OF STUDY COHORTS

Cohort Name	H-ICDA Codes Defining the Cohort	Percentage of 1973 Study Cases
Normal Delivery	650	12.53%
Signs and Symptoms	780-792, 794-796, 564	8.07
Complicated Delivery	651-661	6.60
Pediatric Tonsillectomy	P23.1-23.3	6.10
Dilation and Curettage of Uterus	P71.9	4.97
Cerebrovascular Disease	430-438 (except 438.0)	3.46
Inguinal Hernia Repair	P57.0, P57.1	3.42
Low Back Pain	713.1, 725.1, 726 728.7-728.9	3.29
Acute Myocardial Infarction	410	3.27
Cholecystectomy	P53.5	3.06

Table 19-1 (continued)

Cohort Name	H-ICDA Codes Defining the Cohort	Percentage of 1973 Study Cases
Chronic Lung Disease	490-492, 515-518	2.85
Abdominal Hysterectomy	P71.1	2.79
Pediatric Pneumonia/Bronchitis	480-486, 489	2.69
Neurosis	310	2.49
Adult Pneumonia	480-486	2.45
Uncomplicated Diabetes Mellitus	250.0	2.15
Appendectomy	P49.1	2.04
Breast Biopsy	P39.1, P39.8	2.01
Abortion	640-643	1.81
Cataract Removal	P12.5	1.79
Calculus of Kidney/Ureter	592	1.65
Intracranial Injury	850-854	1.63
Transurethral Prostatectomy	P65.2	1.39
Benign Hypertension	401	1.34
Pediatric Gastroenteritis	008.9, 009 or 561	1.32
Psychosis	306-309	1.32
Tooth Extraction	P40.3-40.4	1.30
Fractured Hip	820.0-820.5	1.17
Hemorrhoidectomy	P51.3	1.12
Pediatric URI	460, 462, 463, 465	1.03
Knee Cartilage Excision	P83.5	0.91
Vaginal Hysterectomy with Cystocele/Rectocele Repair	P71.3	0.90
Complicated Peptic Ulcer	531.1-531.3, 532.1-532.3, 533.1-533.3, 537.0	0.85
Synovitis Treated Surgically	731.1-731.9 with P80, 81 83 (except 83.2), 84, 85, or 86	0.82
Thrombophlebitis of Lower Extremities	451.0	0.77
Varicose Vein Excision	P36.5	0.70
Complete Mastectomy	P39.2-39.5	0.59
Acute Pyelonephritis	590.1	0.59
Vaginal Hysterectomy without Cystocele/Rectocele Repair	P71.4	0.53
Influenza	470	0.50
Cystocele/Rectocele Repair	P73.4	0.47
Osteoarthritis Treated Surgically	713.0 with P80, 81, 83 (except 83.2), 84, 85, or 86	0.39
Pulmonary Embolism	450	0.34
Osteoarthritis Treated Nonsurgically	713.0 without P80, 81, 83 (except 83.2), 84, 85, or 86	0.32
Synovitis Treated Nonsurgically	731.1-731.9 without P80, 81, 83 (except 83.2), 84, 85, or 86	0.19

The case mix index represents the aggregate intensity or costliness of hospital caseload. It is thus clear that all study cohorts should be included in this index and that they should be aggregated in terms

of their expected costliness. The crucial question in the construction of this index is the statistic to use to indicate the expected costliness of each cohort. That is, what statistic should be employed as the weight for combining the different cohorts into a single case mix index?[2]

In the Colorado Hospital Cost Project, conducted by O'Donoghue, Gatch, and Hoffman (1977), statewide (i.e., Colorado-wide) median charge per case was available for each cohort and was used in that project as the indicator of expected costliness in its case mix index. Similar charge information was not available for the hospitals in this study. Further, even if the difference in geographic location could be accepted, the cohorts in these two studies are not the same, making it impossible to directly use median charge per case in Colorado as the costliness weight in this study.

In the absence of charge information, Rafferty (1972) among others has suggested the use of length of stay as the costliness weight in case mix indices. To assess this technique a regression analysis was conducted using the Colorado Project data. In this analysis the dependent variable was statewide median charge per case for each cohort and the independent variable was statewide median length of stay for each cohort. As expected, this analysis shows that length of stay has a strong positive influence on charge per case, accounting for 87% of the variation in the latter.

Because of both this result and substantive considerations, studywide median length of stay,[3] which was available in the CPHA data base, was selected as the basis for the development of the costliness weight for the case mix index. However, length of stay does not fully reflect the costliness per case for some cohorts. For example, length of stay is often short for a complicated delivery; yet the patient receives many ancillary services during her stay. Consequently, the costliness per case is higher than would be indicated by length of

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[2] An alternative approach is to include all 45 cohorts as variables in the Segment III analyses. This approach is unacceptably cumbersome from both operational and substantive viewpoints, especially since the case mix index is used not only as an independent variable in these analyses, but also and more importantly as a dependent variable.

[3] This statistic was calculated by considering all Segment III hospitals as a whole and determining the median length of stay for all cases in the given cohort treated by the hospitals. The alternative procedure of taking the median or average of each hospital's median length of stay for the given cohort unduly weights the experience of those hospitals treating relatively few cases of the given type.

stay alone. Conversely, neurosis patients, who usually receive few ancillary services, exhibit a lower costliness per case than that indicated by length of stay.

To take into account such differences, an intensity adjustment factor was developed for each cohort. This factor primarily reflects ancillary intensity, but also nursing intensity to some extent. In deriving this factor reliance was placed on the study team's knowledge of the characteristics of each cohort. Further, since many cohorts in this project and the Colorado Project are similar, the residuals in the regression equation described above were directly relevant to the construction of this factor. In addition, earlier studies containing intensity data were useful, such as those by Evans and Walker (1972) and Thompson, Fetter, and Mross (1975).

In this study the intensity adjustment factor ranges from .75 to 1.40. It is specified in multiples of five in order to preclude excessive concentration on minor differences. If the intensity adjustment factor for a cohort is greater than 1.0, expected intensity is greater than that indicated by length of stay alone, i.e., average cost per patient day is expected to be higher than average. If the factor is less than 1.0, the implications are the reverse.

Studywide median length of stay for each cohort was multiplied by the cohort's intensity adjustment factor in order to determine the cohort's expected costliness per case, the weight used in the case mix index. Table 19-2 shows these three statistics for each cohort in the index. In this table length of stay is measured in days; expected costliness per case is measured in adjusted days.

Table 19-2

LENGTH OF STAY AND EXPECTED COSTLINESS FOR STUDY COHORTS

Cohort Name	1973 Studywide Median Length of Stay	Intensity Adjustment Factor	1973 Expected Costliness per Case
Acute Myocardial Infarction	15.99	1.10	17.59
Osteoarthritis Treated Surgically	17.03	1.00	17.03
Fractured Hip	19.89	0.85	16.91
Pulmonary Embolism	12.73	1.00	12.73
Psychosis	15.56	0.80	12.45
Transurethral Prostatectomy	10.94	1.00	10.94
Complete Mastectomy	9.34	1.15	10.74
Vaginal Hysterectomy with Cystocele/Rectocele Repair	9.79	1.05	10.28
Cholecystectomy	9.62	1.05	10.10
Complicated Peptic Ulcer	9.89	1.00	9.89

Table 19-2 (continued)

Cohort Name	1973 Studywide Median Length of Stay	Intensity Adjustment Factor	1973 Expected Costliness per Case
Abdominal Hysterectomy	8.65	1.10	9.51
Cystocele/Rectocele Repair	8.96	1.05	9.41
Cerebrovascular Disease	9.88	0.95	9.39
Low Back Pain	9.82	0.90	8.84
Thrombophlebitis of Lower Extremities	10.17	0.80	8.14
Vaginal Hysterectomy without Cystocele/Rectocele Repair	7.45	1.05	7.82
Adult Pneumonia	8.27	0.90	7.44
Uncomplicated Diabetes Mellitus	8.49	0.85	7.22
Oesteoarthritis Treated Nonsurgically	8.48	0.85	7.21
Neurosis	9.12	0.75	6.84
Benign Hypertension	6.60	1.00	6.60
Chronic Lung Disease	6.86	0.95	6.52
Hemorrhoidectomy	6.39	0.95	6.07
Complicated Delivery	4.29	1.40	6.01
Knee Cartilage Excision	5.70	1.05	5.98
Cataract Removal	5.69	1.00	5.69
Varicose Vein Excision	5.14	1.10	5.65
Appendectomy	4.90	1.10	5.39
Pediatric Pneumonia/Bronchitis	5.32	1.00	5.32
Inguinal Hernia Repair	5.15	1.00	5.15
Acute Pyelonephritis	5.77	0.85	4.90
Signs and Symptoms	4.68	1.00	4.68
Normal Delivery	3.68	1.20	4.42
Synovitis Treated Nonsurgically	5.15	0.85	4.38
Calculus of Kidney/Ureter	4.48	0.90	4.03
Influenza	5.20	0.75	3.90
Pediatric URI	3.74	0.85	3.18
Pediatric Gastroenteritis	3.86	0.80	3.09
Synovitis Treated Surgically	2.50	1.15	2.87
Breast Biopsy	2.44	1.15	2.81
Dilation and Curettage of Uterus	2.28	1.10	2.51
Tooth Extraction	2.13	1.15	2.45
Intracranial Injury	2.68	0.75	2.01
Abortion	1.76	1.05	1.85
Pediatric Tonsillectomy	1.50	1.05	1.57

The formula for the case mix index, shown below, resembles that of a Laspeyres-type price index.[4] As noted earlier, all 45 study cohorts are included in this index.

$$CM_i = \left[\frac{\sum_{j=1}^{45} I_{sj} C_{ij}}{\sum_{j=1}^{45} I_{sj} C_{sj}} \right]_i ,$$

where CM_i = Case mix index for the i^{th} hospital

I_{sj} = Expected costliness per case

C_{ij} = i^{th} hospital's percentage of total study cases falling into the j^{th} cohort

C_{sj} = Studywide percentage of total study cases falling into the j^{th} cohort

If the C_{ij}s of a hospital equal the C_{sj}s, the case mix index for that hospital equals 1.0. Conversely, the greater the difference between the C_{ij}s of the hospital and the C_{sj}s, the greater will be the index's divergence from 1.0. However, it is possible for a hospital's C_{ij}s to differ substantially from the corresponding C_{sj}s, and the value of this index will still approximate 1.0 for this hospital. This is because the C_{ij}/C_{sj} differences may be mutually offsetting in terms of cost implications. The hospital may treat a high fraction of some cohorts with high I_{sj}s, but also a high fraction of other cohorts with low I_{sj}s.

The case mix index is dominated by cohorts with a high C_{sj} and either a high or low I_{sj}. In 1973 the strongest positive correlations between the index and its component cohorts are those involving cerebrovascular disease and acute myocardial infarction, both of which have high C_{sj}s and high I_{sj}s. Conversely, the strongest negative correlations involve

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[4] Feldstein (1967) discussed how Paasche-type and Laspeyres-type indices could be used to represent the "costliness" of ward expenses per case. Unfortunately, data constraints precluded his estimation of the Laspeyres-type index and limited his application of the Paasche-type index to broad, heterogeneous cohorts such as infectious disease, urology, and diseases of the chest. The appendicitis equivalent value index and the resource need index developed by CPHA are also case mix measures similar in concept to the case mix index of this study (Ament and Loup [1974] and Ament [1976]).

pediatric tonsillectomy and normal delivery, which have high C_{sj}s, but low I_{sj}s. Similar findings were obtained in 1970.

In 1973 the strongest correlation between the case mix index and any of its components is .61, exhibited by cerebrovascular disease. The highest extent of common variation between the index and any cohort is thus 37%. Hence, no single cohort could be used as a proxy for the entire index, even if such were desirable from a substantive viewpoint.

One objective in defining the study cohorts was to specify homogeneous cohorts in terms of costliness. That is, the objective was to create cohorts whose expected costliness per case was unimodal with a narrow dispersion. As indicated earlier, it was not possible to fully attain this objective. The case severity index was therefore developed to characterize differences in costliness within cohorts, in contrast to the case mix index which indicates differences in costliness among cohorts.

In the case severity index, severity is defined to include both the inherent seriousness of the case and the dominant nature of the services provided. Among the statistics available in the CPHA data base, length of stay is best suited to represent the differences in severity.[5] To illustrate this point, consider the examples used in Chapter 18 to describe case severity -- intracranial injury and benign hypertension. An individual with a serious head injury requires a much longer period of hospitalization than a patient admitted for observation with a moderate concussion. Similarly, a thorough evaluation of a hypertensive patient necessitates a longer hospital stay than a limited work-up designed to improve maintenance therapy for a similar patient.

Utilization practices can also affect length of stay for specific cohorts. Given its definition as the customary length of stay employed by physicians for similar cases, the utilization practices index must be constructed in terms of length of stay. Since length of stay is also used in the case severity index, the crucial issue in the development of these indices is the identification of those cohorts for which it is likely that length of stay is dominated by case severity, and those cohorts for which it is likely that length of stay is dominated by utilization practices. The former cohorts are included in the case severity index and the latter in the utilization practices index.

To an even greater extent than in the case mix index, median length of stay is a more accurate measure than mean length of stay in these

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[5] Although their context is different, Roemer, Moustafa, and Hopkins (1968) argue persuasively that length of stay is heavily influenced by case severity and is thus a good indicator of case severity.

indices since the former is less sensitive than the latter to outliers. Cases with very long lengths of stay occasioned by unexpected and severe complications will have little influence on the median length of stay of individual hospitals. However, such cases could substantially impact the mean length of stay of individual hospitals especially if the hospital treats few patients in the specific cohort. The same point applies to studywide median and mean lengths of stay, but its importance is diminished because of the large number of cases in each cohort.

As expected, not all hospitals treat cases in all 45 cohorts. If the number of cases in a particular cohort treated by a hospital is very low, even the median length of stay becomes unduly sensitive to the unusual case. The rule was therefore established for these indices that if a hospital treated less than three cases in a given cohort during a given year, that hospital would be shown as having missing data for the median length of stay for that cohort and year.

Three conditions were adopted to assure substantial commonality across hospitals in terms of the cohorts in the case severity index and in terms of the cohorts in the utilization practices index. If these conditions had not been employed, either index could have been inaccurate, since it might have reflected differences in cohorts among hospitals as well as differences in prevailing lengths of stay for the same cohorts.

The first condition specified that a cohort included in either index must contain at least .75% of total study cases in both study years, i.e., its C_{sj} had to be at least .75% in both years. This condition proved not unduly limiting since the qualifying cohorts encompassed approximately 95% of total study cases in both years. Second, after the minimum case adjustment described above, each cohort must be treated in both study years by at least 80% of study hospitals, i.e., at least 83 Segment III institutions had to have a positive L_{ij} for each cohort in the index. The third condition required that each hospital have data for the median length of stay of at least one half the cohorts in each index. In actual practice this condition proved nonbinding since the attainment of the first two conditions resulted in its satisfaction.

Each cohort meeting the first two of these conditions was placed in one of three categories according to its distinctive characteristics. The first category encompasses those cohorts for which it is likely that length of stay is dominated by case severity; the second is comprised of those cohorts for which it is probable that utilization practices is the main determinant of length of stay; and the third category is composed of those cohorts for which it is uncertain whether case severity or utilization practices has the dominant influence on length of stay. Table 19-3 displays the resulting categorization of the more frequent study cohorts. For orientation purposes, it also indicates the 1973 C_{sj} for these cohorts.

Table 19-3

FACTOR DOMINATING LENGTH OF STAY
OF FREQUENT COHORTS

Cohort Name	1973 C_{sj}	Factor Expected to Dominate Length of Stay
Normal Delivery	12.53%	Utilization Practices
Signs and Symptoms	8.07	Uncertain
Complicated Delivery	6.60	Uncertain
Pediatric Tonsillectomy	6.10	Utilization Practices
Dilation and Curettage of Uterus	4.97	Utilization Practices
Cerebrovascular Disease	3.46	Case Severity
Inguinal Hernia Repair	3.42	Utilization Practices
Low Back Pain	3.29	Case Severity
Acute Myocardial Infarction	3.27	Uncertain
Cholecystectomy	3.06	Uncertain
Chronic Lung Disease	2.85	Uncertain
Abdominal Hysterectomy	2.79	Utilization Practices
Pediatric Pneumonia/Bronchitis	2.69	Case Severity
Neurosis	2.49	Uncertain
Adult Pneumonia	2.45	Uncertain
Uncomplicated Diabetes Mellitus	2.15	Case Severity
Appendectomy	2.04	Uncertain
Breast Biopsy	2.01	Utilization Practices
Abortion	1.81	Utilization Practices
Calculus of Kidney/Ureter	1.65	Case Severity
Intracranial Injury	1.63	Case Severity
Benign Hypertension	1.34	Case Severity
Pediatric Gastroenteritis	1.32	Case Severity
Fractured Hip	1.17	Uncertain
Hemorrhoidectomy	1.12	Utilization Practices
Pediatric URI	1.03	Uncertain
Complicated Peptic Ulcer	0.85	Case Severity
Thrombophlebitis of Lower Extremities	0.77	Uncertain

Both the case severity and utilization practices indices are constructed using the same formula, which is shown on the following page. As emphasized earlier, the cohorts included in these indices are mutually exclusive. The preliminary case severity index included the nine cohorts shown in Table 19-3 as being dominated by this factor; and the preliminary utilization practices index included the eight cohorts shown in the same table as being dominated by this factor. In these indices if the L_{ij} is missing for a hospital, the corresponding L_{sj} is deleted from the denominator.

$$CS_i \text{ or } UP_i = \left[\frac{\sum_{j=1}^{n} L_{ij}}{\sum_{j=1}^{n} L_{sj}} \right]_i ,$$

where CS_i = Case severity index for the i^{th} hospital
UP_i = Utilization practices index for the i^{th} hospital
L_{ij} = i^{th} hospital's median length of stay for the j^{th} cohort
L_{sj} = Studywide median length of stay for the j^{th} cohort

Analogous to the case mix index, if a hospital's L_{ij}s for either index approximate the L_{sj}s, the value of the index for that hospital will approximate 1.0. The greater the extent to which the L_{ij}s differ from the L_{sj}s, the greater will be the divergence between the index and 1.0. It is possible, but less likely than with the case mix index, that one cohort's divergence from the studywide pattern will be balanced by another cohort's deviation in the opposite direction. For example, in the case severity index a long length of stay for pediatric pneumonia/bronchitis might be offset by a short length of stay for low back pain.

In these indices weights other than 1.0 were not employed since there is no persuasive rationale for expecting one cohort to more effectively represent case severity or utilization practices than does another cohort. Consideration was also given to standardizing the lengths of stay of the cohorts in these indices, but such a procedure was not undertaken since neither case severity nor utilization practices are systematically reflected across different cohorts in equiproportional variations from median length of stay.

As stressed earlier, since the index components are intended to characterize either case severity or utilization practices, a positive correlation should exist between the index and each of its components. If this correlation were negative or insignificant, the presumption would be that the cohort had been mistakenly placed in the index. Consequently, the condition was established for both indices that there must be a positive correlation significant at the .05 level in a one-tailed test (i.e., a correlation of at least .17) between the index and each of its components.

All nine cohorts in the preliminary case severity index met this condition and are included in the final index. Two of the eight cohorts in the preliminary utilization practices index -- normal delivery and pediatric tonsillectomy -- did not satisfy this condition. Since their median lengths of stay were insignificantly correlated with the preliminary index, they were deleted. The resulting final utilization practices index contains six cohorts.

As shown in Table 19-4, each component of the case severity index is highly correlated with the index in 1973. The strongest correlation (.71) involves low back pain, while the lowest correlation (.46) involves intracranial injury. Similar results characterize the utilization practices index. The highest correlation between the index and one of its components is that involving abdominal hysterectomy (.79); the lowest correlation is .50, a finding characterizing both abortion and dilation and curettage of uterus. Approximately the same results were obtained in 1970, with the components most correlated with the case severity and utilization practices indices again being low back pain and abdominal hysterectomy respectively.

Table 19-4

CORRELATIONS OF 1973 CASE SEVERITY AND UTILIZATION PRACTICES INDICES WITH THEIR COMPONENTS

Case Severity Components	Case Severity Index	Utilization Practices Index
L_{ij} for Cerebrovascular Disease	.65	.39
L_{ij} for Low Back Pain	.71	.01
L_{ij} for Pediatric Pneumonia/Bronchitis	.53	.28
L_{ij} for Uncomplicated Diabetes Mellitus	.75	.27
L_{ij} for Calculus of Kidney/Ureter	.69	.21
L_{ij} for Intracranial Injury	.46	.09
L_{ij} for Benign Hypertension	.66	.24
L_{ij} for Pediatric Gastroenteritis	.49	.16
L_{ij} for Complicated Peptic Ulcer	.59	.38
Utilization Practices Components		
L_{ij} for Dilation and Curettage of Uterus	.27	.50
L_{ij} for Inguinal Hernia Repair	.28	.78
L_{ij} for Abdominal Hysterectomy	.28	.79
L_{ij} for Breast Biopsy	.33	.67
L_{ij} for Abortion	.14	.50
L_{ij} for Hemorrhoidectomy	.18	.59

Both the case severity and utilization practices indices are based on the median lengths of stay of different cohorts. Further, the formula for these indices is the same. Yet these indices are intended to represent distinctly different endogenous variables. Consequently, it is important to examine the correlations between each index and the components of the other index. To operationalize this test, the condition was established that each index component must be more highly correlated with its own index than with the other index.

As indicated in Table 19-4, this condition was easily attained by all index components in 1973. It was also easily satisfied by all components in 1970. For the case severity components, the widest difference in 1973 involves low back pain, whose correlations are .71 and .01 with the case severity and utilization practices indices respectively. The narrowest difference for a case severity component involves complicated peptic ulcer, which is correlated at .59 and .38 with the case severity and utilization practices indices respectively. Abdominal hysterectomy exhibits the widest difference among the utilization practices components. Its correlations are .79 and .28 with the utilization practices and case severity indices respectively. Dilation and curettage of uterus displays the smallest difference for a utilization practices component. Its correlations are .50 with its own index and .27 with the case severity index.[6]

The elective surgery index indicates the prevalence of elective surgery patients in the hospital's caseload. In this index elective surgery is defined as those surgical procedures (and thus those surgical cohorts) meeting two conditions. First, in most instances it must be possible to schedule the procedure in advance. That is, the procedure is not usually an emergency operation. Second, the procedure must generally be performed on individuals in good health except for the problem addressed by the operation. Because of this condition operations predominantly performed on the elderly, e.g., cataract removal and transurethral prostatectomy, were excluded from this index. Based on these two conditions, the eight surgical cohorts shown on the next page were included in the elective surgery index.

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[6] O'Donoghue, Gatch, and Hoffman (1977) used case severity and utilization practices indices in the Colorado Project. They were constructed according to the formula used here, but included somewhat different cohorts. Similar correlation results were obtained in that study, i.e., each index component was not only significantly correlated with its own index, but was more strongly associated with that index than with the other index.

- Pediatric Tonsillectomy
- Dilation and Curettage of Uterus
- Hysterectomy and Related Conditions[7]
- Inguinal Hernia Repair
- Cholecystectomy
- Knee Cartilage Excision
- Synovitis Treated Surgically
- Varicose Vein Excision

These eight cohorts were combined through the following formula to create the elective surgery index. No weights other than 1.0 were used in this index since it is inappropriate to emphasize any of the surgical cohorts to a greater or lesser extent than their occurrence in the hospital population.

$$ES_i = \left[\frac{\sum_{j=1}^{n} C_{ij}}{\sum_{j=1}^{n} C_{sj}} \right]_i ,$$

where ES_i = Elective surgery index for the i^{th} hospital

C_{ij} = i^{th} hospital's percentage of total study cases falling into the j^{th} cohort

C_{sj} = Studywide percentage of total study cases falling into the j^{th} cohort

The elective surgery cases encompass a substantial block of hospital patients, accounting for approximately 25% of study cases. The most frequent cohort is pediatric tonsillectomy with a 1973 C_{sj} of 6.10%; the least frequent cohort is varicose vein excision with a 1973 C_{sj} of .70%.

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[7] In this index as well as in the quality index discussed later, the single cohort hysterectomy and related conditions is used in place of the four smaller cohorts comprising it -- abdominal hysterectomy, vaginal hysterectomy with cystocele/rectocele repair, vaginal hysterectomy without cystocele/rectocele repair, and cystocele/rectocele repair.

The correlations between the elective surgery index and its components are all substantially positive in 1973, as displayed in Table 19-5. Similarly, these correlations are all significantly positive in 1970. In 1973 the highest correlation between this index and a component is .67, exhibited by pediatric tonsillectomy; the lowest correlation is .29, displayed by synovitis treated surgically. Since all components are synchronous with the index, none need be eliminated. Conversely, none are so strongly correlated with the index that a single component could replace it.[8]

Table 19-5

CORRELATIONS OF 1973 ELECTIVE SURGERY INDEX WITH ITS COMPONENTS

Index Component	Elective Surgery Index
C_{ij} for Pediatric Tonsillectomy	.67
C_{ij} for D and C of Uterus	.58
C_{ij} for Hysterectomy and Related Conditions	.62
C_{ij} for Inguinal Hernia Repair	.49
C_{ij} for Cholecystectomy	.49
C_{ij} for Knee Cartilage Excision	.32
C_{ij} for Synovitis Treated Surgically	.29
C_{ij} for Varicose Vein Excision	.56

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[8] Consideration was given in this study to the creation of a mandatory admissions index, which would have been used as a complement to both the elective surgery and utilization practices indices. This index foundered because of two cohorts -- normal delivery and complicated delivery.

At least in the Midwest during the study years, it was considered mandatory to deliver infants in hospitals. It was therefore essential to include these cohorts in this index. Partially because of their frequency, these cohorts exhibited very high correlations with the index, but their inclusion produced generally insignificant correlations between the index and other mandatory admission cohorts, such as appendectomy, fractured hip, and acute myocardial infarction. It was consequently not possible to include a mandatory admissions index in this study.

As is appropriate, the means of the case intensity and utilization practices indices are close to 1.00. In 1973 this statistic equals precisely 1.00 for the case mix index; .94 for the case severity index; 1.03 for the utilization practices index; and .95 for the elective surgery index. The coefficient of variation is highest for the latter index, equalling .25. It is approximately the same for the case severity and utilization practices indices, equalling .17 and .13 respectively. This statistic is lowest, .06, for the case mix index, meaning that there is only modest variation in case mix among study hospitals. While this finding is surprising, it is nonetheless consistent with the analogous result reported by O'Donoghue, Gatch, and Hoffman (1977).

None of these variables changed appreciably during the study period. For each index, the percentage change measure averaged less than 1%. However, the degree of variation in the percentage change measures differs substantially. The standard deviation of the percentage change in case mix is .04. This statistic equals .09 and .11 respectively for the percentage changes in utilization practices and case severity. It is highest (.14) for the percentage change in elective surgery.

The correlations between case mix and case severity are insignificant in both study years as is the correlation between the percentage changes in these variables. Given the strong positive effects of both indices on length of stay (to be described later), this finding points up the value of using both indices.

The correlation between case severity and utilization practices is .37 in 1973. It is .28 in 1970, and the correlation between the percentage changes in these variables is .35. While significant, none of these correlations is so high as to imply that the variable construction process was not successful in separating cohorts whose length of stay is dominated by case severity from cohorts whose length of stay is dominated by utilization practices. This is especially true given the correlations described earlier between these indices and their components.

Additional evidence supporting the distinctiveness of these indices is that case severity is positively correlated with average salary, while utilization practices is negatively correlated with this variable. Similarly, case severity has a strong negative correlation with labor productivity, whereas utilization practices is insignificantly associated with this variable.

As expected, utilization practices and case mix are insignificantly associated. The variable most strongly associated with elective surgery is case severity, with the correlations between these variables being .21 and .35 in 1973 and 1970 respectively. Elective surgery is negatively correlated with the other two indices, but only at the borderline of statistical significance.

Patient Mix and Length of Stay

Length of stay and elderly caseload are defined in the same way in this segment as in the preceding segments. The former equals patient days divided by cases, and the latter equals Medicare patient days divided by total patient days. Neither ECF nor newborn infant utilization are included in length of stay. ECF utilization is also excluded from elderly caseload. Patient days are employed in the elderly caseload variable instead of cases, because there is some missing data for Medicare cases.

The white caseload index is drawn from the CPHA data base. It equals the percentage of the study case base which is classified by the hospital as white. Analogous to the other CPHA indices, although based only on these cases, white caseload is designed to be representative of all hospital cases. As discussed earlier, this is a valid thesis, since the study case base comprises more than 50% of total hospital cases and includes a wide variety of cohorts.

In 1973 mean length of stay is 7.48, almost precisely the same as the average for this variable in Segment I. Similarly, average elderly caseload in 1973 is almost the same in the two segments, equalling .37 in this segment and .38 in Segment I. Neither of these variables changed substantially during the study period. Length of stay declined by 4%, while elderly caseload rose by 5%. The coefficient of variation for these variables is moderate in 1973. It equals .16 for length of stay and .24 for elderly caseload.

White caseload averages .95 in 1973; its coefficient of variation in that year is low, .05. White caseload changes very little during the study period. Its average percentage change approximates zero, and even more important, the standard deviation of its percentage change variable is very low, .01.

There is a strong positive association between elderly caseload and white caseload. Their correlation is .49 in both study years. The percentage changes in these variables are, however, insignificantly associated. White caseload is negatively correlated with length of stay, but only at the borderline of statistical significance. The percentage changes in these variables are insignificantly associated. Surprisingly, the correlation between elderly caseload and length of stay is insignificant in 1973. It is positive and narrowly significant in 1970, .17. However, the correlation between the percentage changes in these variables is higher, .30.

As discussed in the preceding chapter, it is likely that length of stay is strongly influenced by case intensity, utilization practices, and patient mix. To determine the extent of these effects, regression analyses were performed with length of stay as the dependent variable and the other factors as independent variables. In these analyses case severity and case mix have powerful positive effects on length

of stay, together accounting for more than 50% of the variation in length of stay. Utilization practices also has a positive impact on length of stay, but the magnitude of its effect is much smaller than those of case severity and case mix. Despite their modest correlations with length of stay, both patient mix measures have significant effects on this variable. Elderly caseload has a positive impact and white caseload a negative influence. As expected, elective surgery has an insignificant effect on length of stay.

These results support the substantive framework of Segment III. In particular, they substantiate the rationale for expecting the Indiana Program to have an insignificant influence on length of stay.

Quality

There are four general types of quality measures.[9] One is the health status index which measures the health of a population. Mortality and life expectancy rates are examples of such indices, as are morbidity measures such as school days lost, days absent from work, and days of restricted activity. Even if a data source had been available to this study for the construction of an index of this type, a health status measure would have been inappropriate since this study's unit of analysis is the individual hospital rather than a defined population.

The second type of quality index is the clinical outcome measure. It asks the question: What was the outcome of an episode of care? For example, what was the recurrence rate for inguinal herniorrhaphy? What percentage of patients treated for urinary tract infection had recurrent infections six months later? What percentage of heart attack patients hospitalized for more than two days died? Clinical outcome measures have a number of strengths, with the most important being the fact that they are founded directly upon the impact of health services on health status. However, the CPHA data base does not contain sufficient measures of this type to permit the construction of a clinical outcome index. Moreover, there were no other data sources available which contained such information about the project hospitals during the study years.

A third type of quality index is the input measure, directed toward the question: Is the number of inputs sufficient? For example, is the ratio of nursing personnel to admissions sufficiently high? Input measures are useful if it can be established that a specific set of

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[9] A number of individuals have played important roles in furthering the development and acceptance of this paradigm for classifying quality measures. Especially important have been Donabedian (1966 and 1973); Brook (1972); Brook, Davies-Avery, et al. (1977); Payne et al. (1976); Williamson (1971); DeGeyndt (1970); and Ellwood, O'Donoghue, McClure, et al. (1973).

inputs makes an entity a particular "something," such as a hospital or a nursing home. In this instance a criterion based on a measure encompassing these inputs can be employed to prevent fraud since its satisfaction can be specified as a condition for entry into the industry. However, input measures have a severe weakness. By definition their use establishes a tautology in which high quality is equivalent to high cost and low productivity. For example, if the ratio of nursing personnel to admissions is used to assess hospital quality, and if hospitals are thus encouraged to increase this ratio, the mirror image productivity measure of admissions/nursing personnel will fall. If hospital quality is assessed in terms of the breadth of facilities and equipment, hospitals are given an incentive to increase their capital inputs and lower their capital productivity.

The fourth type of quality index is the process measure. Its objective is to indicate whether patient management was in accord with accepted medical practice. For example, what percentage of patients with a kidney/ureteral calculus received an intravenous pyelogram? What percentage of pediatric gastroenteritis cases had a stool culture? The advantage of process measures is that they are more directly related to the effectiveness of hospital care than are input measures. That is, they are more directly based on the impact hospital services have on health status. Moreover, they do not imply a tight linkage between high quality and high cost/low productivity.

Their main disadvantage is that they are heavily dependent on the existing state of medical knowledge. However, input measures suffer from the same liability. Theoretically, process measures are thus superior to input measures. Since the CPHA data base permits the construction of process measures, a quality index of this type was used in this study.[10]

The quality index was constructed according to the formula shown on the next page.[11] Like the case severity and utilization practices variables, in this index if a hospital exhibits missing data for a Q_{ix}, the corresponding Q_{sx} is deleted from the denominator for that hospital. The Q_{sx}s are calculated in a manner analogous to the L_{sj}s used in the case severity and utilization practices variables. That is, a Q_{sx} indicates the average performance on a particular quality measure across all study patients in the relevant cohort, rather than the average performance of study hospitals on this measure.

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[10] While the quality index is a process quality measure, the basic service mix index (discussed later in this chapter) is partially an input quality measure, since it represents those services which hospitals should have in order to function effectively.

[11] A somewhat similar methodology was applied to physician data, rather than hospital data, by Payne et al. (1976) in their construction of the Physician Performance Index.

$$Q_i = \left[\frac{\sum_{x=1}^{n} Q_{ix}}{\sum_{x=1}^{n} Q_{sx}} \right]_i ,$$

where Q_i = Quality index for the i^{th} hospital
Q_{ix} = i^{th} hospital's performance on the x^{th} quality measure
Q_{sx} = Studywide performance on the x^{th} quality measure

Like the case intensity and utilization practices variables, if a hospital's performance on the individual quality measures closely approximates the studywide performance on those measures, that hospital's value for the quality index will approach 1.0. That is, if the Q_{ix}s approximate the Q_{sx}s, the value of Q_i will be close to 1.0. If a hospital's performance is consistently better than the studywide average, the value of its quality index will be greater than 1.0. If its performance is generally worse, the value of its quality index will be less than 1.0.

If a hospital treats very few cases in a particular cohort, the quality measures drawn from that cohort become unreliable for that hospital. Consequently, a "rule of three" was invoked for this index as it was for the case severity and utilization practices indices. That is, if a hospital admitted less than three patients in a given cohort during a given year, it was shown as having missing data for the quality measures based on that cohort in that year.

The accuracy of the quality index suffers if there is not strong commonality among hospitals in terms of the quality measures in the index. The same three conditions were therefore adopted for this index as were employed for the utilization practices and case severity variables. First, to be included in the quality index a cohort had to represent at least .75% of the study case base in both 1973 and 1970. Second, after the above-described minimum case adjustment, each cohort in this index had to be treated in both study years by at least 80% of Segment III hospitals. Third, each hospital had to have data for at least one half of the quality measures in this index. Again, satisfaction of the first two conditions made the third condition nonconstraining. In fact, most study hospitals have complete data for all the components of the quality index.

The most important step in the development of the quality index was the specification of individual process measures for this index. The starting point for this task was the study team's knowledge of the medical characteristics of different cohorts. Essential input was then obtained from ten sets of medical criteria largely prepared by

different physician organizations.[12] In addition, important insights were provided by the participants in the quality/case intensity conference convened as part of this project.

Several considerations guided the selection of individual process measures. First, the scope of the quality measures was confined to the breadth of the CPHA data base -- a condition which imposed definite limitations. However, the implied criticism in this statement must be tempered by the realization that the CPHA data set was developed by that organization for application across a wide variety of cohorts and hospitals. Hence, a high degree of specificity for one cohort might constrain the use of the same data set for other cohorts.

A related point is that this study's construction of quality measures took into account specific properties of the CPHA data set. For example, one of the CPHA case abstract sections requests that the hospital indicate for each case the occurrence of hospital infection or other hospital complications. It has been CPHA's experience that hospitals are generally reluctant to overtly record the presence of a hospital complication, even if it occurred. Accordingly, data drawn from this portion of the case abstract was not used.

A second consideration was that each process measure had to be specified as a frequency, i.e., as the percentage of cases of a certain type receiving a particular diagnostic or therapeutic procedure. Further, each measure had to be unidirectional and stated in such a way that 100% was the best value attainable on the measure and 0% the worst value. This condition means that all process measures in this study are directed toward situations where it is accepted medical practice to perform the specified procedure for essentially all cases in the particular cohort.[13] This condition thus excludes process measures for which the accepted norm is 60% or 75%. Although possible in theory, it is difficult in practice to include in an aggregate

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[12] The criteria sets used were those developed by Metropolitan Health Care Foundation of Minneapolis-St. Paul (1971); Utah Professional Review Organization (1974); Multnomah Foundation for Medical Care (1974); American Academy of Orthopaedic Surgeons (1974); Hospital Utilization Project (1973); University of Michigan Medical School (1968); Pennsylvania Medical Society (1974); American Academy of Pediatrics (1974); Mississippi State Medical Association (1974); and Overlook Hospital in Summit, New Jersey (1974).

[13] Highly unusual cases occur in which a specific procedure is not indicated. For example, there may be isolated cholecystectomy patients who should not receive a chest x-ray. Such cases are not an important consideration in the construction of the quality index. By their very infrequency they do not significantly influence the value of this index for different hospitals.

quality index process measures addressed to procedures which should be performed in many, but not all, cases in a given cohort.

A third consideration is that since the quality index is directed toward the effectiveness of hospital care, it is preferable to focus process measures on procedures which are central to patient management. While the limitations of the CPHA data base prevented full attainment of this goal, a strong effort was made in this direction. The specification of a complete blood count (c.b.c.) and urinalysis for different cohorts reflects this effort. It can be justifiably argued that all hospital patients should have these tests. It could thus be argued that these tests should be specified for all the cohorts in the quality index. However, in many cohorts the provision of a c.b.c. and urinalysis is a peripheral component of patient care. Consequently, if these two tests were specified for all cohorts in the quality index, they would unduly weight the index. Therefore, with the partial exception of elective surgery, c.b.c.s and urinalyses are included as quality measures only for those cohorts in which these tests are an integral part of mainline patient management.

Based upon these considerations, the distinguishing medical characteristics of different cohorts, and the frequency conditions described earlier, the 65 process measures specified in Table 19-6 were included in the preliminary quality index. This table also indicates the 1973 Q_{sx} for each of these measures. The measures are drawn from 16 cohorts which span the types of care provided by hospitals. As indicated by its formula, weights other than 1.0 were not necessary in the quality index, since the importance of individual process measures does not differ substantially.

Table 19-6

COMPONENTS OF PRELIMINARY QUALITY INDEX

Index Component	1973 Studywide Performance
Hysterectomy and Related Conditions	
Percentage of cohort patients with c.b.c.	97.9%
Percentage of cohort patients with urinalysis	97.8
Percentage of cohort patients with chest x-ray	60.6
Percentage of cohort patients aged at least 40 with EKG	45.8
Percentage of cohort patients not receiving one unit of blood	97.0
Percentage of abdominal hysterectomy patients not having a tissue diagnosis of No Disease	95.5

Table 19-6 (continued)

Index Component	1973 Studywide Performance
Inguinal Hernia Repair	
Percentage of cohort patients with c.b.c.	98.0 %
Percentage of cohort patients with urinalysis	97.3
Percentage of cohort patients with chest x-ray	61.3
Percentage of cohort patients aged at least 40 with EKG	57.5
Acute Myocardial Infarction	
Percentage of cohort patients with transaminase/LDH tests	92.4
Percentage of cohort patients with electronic monitoring	66.8
Percentage of cohort patients with electrolyte tests	87.3
Percentage of cohort patients with cholesterol/ lipids tests	75.8
Percentage of cohort patients with chest x-ray	82.5
Percentage of cohort patients with a length of stay greater than 0 days who have more than one EKG	85.7
Cholecystectomy	
Percentage of cohort patients with chest x-ray	70.3
Percentage of cohort patients aged at least 40 with EKG	64.1
Percentage of cohort patients with liver function studies	75.1
Percentage of cohort patients with intravenous or operative cholangiography	29.5
Percentage of cohort patients with tissue diagnosis of Diseased A	77.6
Chronic Lung Disease	
Percentage of cohort patients with chest x-ray	88.4
Percentage of cohort patients with EKG	56.2
Percentage of cohort patients with c.b.c.	97.0
Percentage of cohort patients with inhalation therapy	55.0
Adult Pneumonia	
Percentage of cohort patients with sputum culture	55.3
Percentage of cohort patients with chest x-ray	95.3
Percentage of cohort patients aged at least 40 with EKG	67.5
Percentage of cohort patients with antibiotics who have an antibiogram	34.6
Percentage of cohort patients with diagnosis of bacterial/unspecified pneumonia who are given antibiotics or sulfa drugs	88.1
Uncomplicated Diabetes Mellitus	
Percentage of cohort patients with BUN test	87.5
Percentage of cohort patients with funduscopic examination	24.9
Percentage of cohort patients with chest x-ray	75.1
Percentage of cohort patients aged at least 40 with EKG	72.5

Table 19-6 (continued)

Index Component	1973 Studywide Performance
Appendectomy	
Percentage of cohort patients with rectal or pelvic examination	42.9 %
Percentage of cohort patients with chest x-ray	40.8
Percentage of cohort patients with c.b.c.	96.5
Percentage of cohort patients with urinalysis	95.7
Percentage of cohort patients with a tissue diagnosis of Diseased A who do not have the overall diagnosis of acute appendicitis with peritonitis	58.9
Calculus of Kidney/Ureter	
Percentage of cohort patients with intravenous pyelogram	70.3
Percentage of cohort patients with urine culture	44.6
Percentage of cohort patients with multichannel chemistry/BUN tests	85.6
Percentage of cohort patients with c.b.c.	95.8
Percentage of cohort patients with urinalysis	96.6
Intracranial Injury	
Percentage of cohort patients with skull x-ray	6.3
Percentage of cohort patients with c.b.c.	94.1
Benign Hypertension	
Percentage of cohort patients with BUN test	91.6
Percentage of cohort patients with electrolyte tests	89.3
Percentage of cohort patients with EKG	82.4
Percentage of cohort patients with chest x-ray	81.6
Pediatric Gastroenteritis	
Percentage of cohort patients with stool culture	47.6
Percentage of cohort patients with electrolyte tests	44.3
Percentage of cohort patients with urinalysis	94.6
Percentage of cohort patients with c.b.c.	97.4
Fractured Hip	
Percentage of cohort patients with chest x-ray	77.4
Percentage of cohort patients with EKG	77.0
Pediatric URI	
Percentage of cohort patients with chest x-ray	74.0
Percentage of cohort patients with throat/nose culture	58.9
Percentage of cohort patients with c.b.c.	97.0
Complicated Peptic Ulcer	
Percentage of cohort patients with stool-for-blood test	34.3
Percentage of cohort patients with electrolyte tests	83.2
Percentage of cohort patients aged at least 40 with EKG	61.0
Percentage of cohort patients not receiving one unit of blood	95.0
Thrombophlebitis of Lower Extremities	
Percentage of cohort patients with chest x-ray	70.6
Percentage of cohort patients with EKG	53.2

Each process measure is intended to represent the same endogenous variable, i.e., quality of hospital care. Accordingly, each measure should be positively associated with the index at least at the .05 level in a one-tailed test. That is, the correlation of each measure with the index should be at least .17. When this condition was applied to the process measures in 1973, the result was deletion of the following six measures from the quality index.

- Hysterectomy and Related Conditions
  - percentage of cohort patients not receiving one unit of blood
  - percentage of abdominal hysterectomy patients not having a tissue diagnosis of No Disease[14]
- Cholecystectomy
  - percentage of cohort patients with a tissue diagnosis of Diseased A[14]
- Adult Pneumonia
  - percentage of cohort patients with a diagnosis of bacterial/unspecified pneumonia who are given antibiotics or sulfa drugs
- Appendectomy
  - percentage of cohort patients with a tissue diagnosis of Diseased A who do not have the overall diagnosis of acute appendicitis with peritonitis
- Complicated Peptic Ulcer
  - percentage of cohort patients not receiving one unit of blood

During the initial stage of quality index development suspicion was focused on the pathologist report section of the CPHA case abstract. Concern arose that pathologists might be induced to overdiagnose

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[14] Diseased A, Diseased B, and No Disease are three mutually exclusive categories developed by CPHA for describing the contents of pathologist reports. Diseased A means that the pathologic findings justified the removal of the tissue or organ under examination. Diseased B means that the pathologic findings are consistent with the removal of said tissue or organ. No Disease means that the pathologic examination found only normal tissue.

Diseased B and to correspondingly underdiagnose the other two categories. Nonetheless, three measures drawn from this section were included in the preliminary quality index. As noted above, all of these measures were eliminated by the 1973 correlation results, which substantiates initial uneasiness about this part of the case abstract.

Another result of the 1973 correlations was the exclusion of the two measures directed toward the provision of one unit of blood. The rationale for the nonconformance of these measures with the quality index is less clear, although the Q_{sx}s for both measures equal at least 95%.

After excluding the six measures noted above, all remaining measures were significantly correlated with the overall index in 1973. Such was not the case in 1970. In this year insignificant correlations existed for 11 process measures, all of which are directed toward the provision of either a c.b.c. or urinalysis. In fact, as a result of these correlation findings, all but two such measures had to be eliminated from the index. The two variables retained were the percentage of hernia patients with urinalysis and the percentage of pediatric gastroenteritis cases with urinalysis.[15] In addition, the skull x-ray measure in the intracranial injury cohort was deleted because its correlation with the overall index was at the borderline of statistical significance.

With the exclusion of these 12 measures, the final quality index includes 47 process measures drawn from 15 cohorts.[16] As shown in

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[15] It is possible that the asynchronism between the quality index and the c.b.c./urinalysis measures arose because of pre-admission testing. This possibility is unlikely for two reasons. First, the data abstractors in the subscribing hospitals were instructed by CPHA to include as a c.b.c. or urinalysis such tests performed during the 48 hours prior to admission. Second, although pre-admission testing was not uncommon among project hospitals during the study years, it often included chest x-rays and other tests in addition to c.b.c.s and urinalyses. However, unlike the c.b.c./urinalysis measures, nonconformance with the quality index was not encountered with the chest x-ray measures.

[16] Analogous to most Segment III variables, the quality index is a proxy or tracer for the quality of care, as opposed to being a census measure of such care. It is clear that all possible process measures (including those outside the scope of the CPHA data base) are not encompassed within the quality index. However, with 47 process measures drawn from 15 cohorts, this index is substantially more comprehensive than what is usually envisioned by the term "tracer quality measure." Kessner, Kalk, and Singer (1973) provide a definitive discussion of the tracer methodology.

Table 19-7, each measure is significantly correlated with the index with the correlations ranging from .74 to .20. The highest correlation involves the percentage of acute myocardial infarction patients with electrolyte tests, and the lowest correlation involves the percentage of chronic lung disease cases receiving inhalation therapy. Similar results were obtained in 1970. In that year the correlations range from .70 to .29. The highest correlation is exhibited by the percentage of adult pneumonia patients aged at least 40 with EKG; the lowest correlation is displayed by the percentage of inguinal hernia repair cases with urinalysis.

Table 19-7

CORRELATIONS OF 1973 QUALITY INDEX
WITH ITS COMPONENTS

Index Component	Quality Index
Hysterectomy and Related Conditions	
Percentage of cohort patients with chest x-ray	.57
Percentage of cohort patients aged at least 40 with EKG	.58
Inguinal Hernia Repair	
Percentage of cohort patients with urinalysis	.32
Percentage of cohort patients with chest x-ray	.51
Percentage of cohort patients aged at least 40 with EKG	.66
Acute Myocardial Infarction	
Percentage of cohort patients with transaminase/LDH tests	.49
Percentage of cohort patients with electronic monitoring	.56
Percentage of cohort patients with electrolyte tests	.74
Percentage of cohort patients with cholesterol/ lipids tests	.56
Percentage of cohort patients with chest x-ray	.72
Percentage of cohort patients with a length of stay greater than 0 days who have more than one EKG	.51
Cholecystectomy	
Percentage of cohort patients with chest x-ray	.65
Percentage of cohort patients aged at least 40 with EKG	.71
Percentage of cohort patients with liver function studies	.58
Percentage of cohort patients with intravenous or operative cholangiography	.31
Chronic Lung Disease	
Percentage of cohort patients with chest x-ray	.57
Percentage of cohort patients with EKG	.57
Percentage of cohort patients with inhalation therapy	.20

Table 19-7 (continued)

Index Component	Quality Index
Adult Pneumonia	
Percentage of cohort patients with sputum culture	.59
Percentage of cohort patients with chest x-ray	.43
Percentage of cohort patients aged at least 40 with EKG	.69
Percentage of cohort patients with antibiotics who have an antibiogram	.39
Uncomplicated Diabetes Mellitus	
Percentage of cohort patients with BUN test	.64
Percentage of cohort patients with funduscopic examination	.23
Percentage of cohort patients with chest x-ray	.67
Percentage of cohort patients aged at least 40 with EKG	.73
Appendectomy	
Percentage of cohort patients with rectal or pelvic examination	.40
Percentage of cohort patients with chest x-ray	.41
Calculus of Kidney/Ureter	
Percentage of cohort patients with intravenous pyelogram	.39
Percentage of cohort patients with urine culture	.56
Percentage of cohort patients with multichannel chemistry/BUN tests	.61
Benign Hypertension	
Percentage of cohort patients with BUN test	.59
Percentage of cohort patients with electrolyte tests	.55
Percentage of cohort patients with EKG	.47
Percentage of cohort patients with chest x-ray	.45
Pediatric Gastroenteritis	
Percentage of cohort patients with stool culture	.51
Percentage of cohort patients with electrolyte tests	.46
Percentage of cohort patients with urinalysis	.34
Fractured Hip	
Percentage of cohort patients with chest x-ray	.63
Percentage of cohort patients with EKG	.64
Pediatric URI	
Percentage of cohort patients with chest x-ray	.45
Percentage of cohort patients with throat/nose culture	.57
Complicated Peptic Ulcer	
Percentage of cohort patients with stool-for-blood test	.31
Percentage of cohort patients with electrolyte tests	.58
Percentage of cohort patients aged at least 40 with EKG	.71
Thrombophlebitis of Lower Extremities	
Percentage of cohort patients with chest x-ray	.52
Percentage of cohort patients with EKG	.60

The mean for the quality index in 1973 is .97, which approximates 1.00 as expected. Its coefficient of variation is moderate, .16, equalling that of length of stay. The average percentage change in this variable is 4%, which is relatively low, but higher than that of many Segment III variables. The standard deviation of the percentage change in quality is .12, which also stands relatively high among Segment III variables.

The correlation pattern of the quality index with other endogenous variables supports its validity. It is positively associated with average salary, and negatively related to labor productivity. Its correlations with case severity and length of stay are positive. Perhaps surprisingly at initial examination, but consistent with the other study results, its correlation with elderly caseload is substantially negative.

Service Mix

The data source for the service mix variables is the AHA Survey, which specifies whether a hospital has a service but does not indicate the intensity with which the service is offered. It was thus impossible to take such intensity into account in the service mix indices of this project. This is not a fatal drawback for two reasons. First, for many services, such as open heart surgery, the initial acquisition of the service is a more significant step than later expansion of the service. Second and more important, the intensity with which services are offered by a hospital is likely to be highly correlated with the number of services provided by the hospital. That is, the breadth and depth of service mix are strongly intertwined, and the former characteristic can be determined from AHA Survey data.

Specialized service mix characterizes the set of technologically advanced services offered by hospitals. All such services are expensive, but some have distinctly greater cost implications. Accordingly, weights were developed to indicate the expected costliness of different services. The following three criteria were used both to determine these weights and to select the services for this index.[17]

> The cost of the service itself. This cost is high for a service like open heart surgery, but low for a service such as organ bank.
>
> The direct cost implications of the service. For example, the substantial costs of cardiac catheterization are implied by the presence of open heart surgery. The

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[17] Shuman, Wolfe, and Hardwick (1972) used similar criteria to develop a service mix index.

existence of an organ bank implies that expensive transplant surgery is being performed.

The indirect cost implications of the service. If open heart surgery is performed in a hospital, the cardiologists and cardiac surgeons attract other heart patients to the hospital who may not receive open heart surgery, but who increase the costliness of the hospital's caseload.

The services eligible for the specialized services index were limited to those available from AHA Survey data for 1970 and 1973. Based on the above criteria, the services shown in Table 19-8 were selected from this eligible set for inclusion in this index. This table also indicates the costliness weight attached to each service.[18]

Table 19-8

COMPONENTS OF SPECIALIZED SERVICES INDEX

Index Component	Expected Costliness
Intensive Care	
Mixed ICU and Cardiac ICU	2
Premature Nursery	2
Specialized Surgery	
Open-Heart Surgery	4
Organ Bank	4
Renal Dialysis	
Inpatient Dialysis	3
Outpatient Dialysis	1
Radiologic/Nuclear Services	
X-Ray Therapy	1
Cobalt Therapy	1
Radium Therapy	1
Diagnostic Radioisotope Facility	1
Other Services	
Occupational Therapy	1
Electroencephalography	1

[18] O'Donoghue, Gatch, and Hoffman (1977) used a specialized service mix index similar in concept to the index used in this project. Partially because the data sources used in the two studies are different, there are moderate differences in the services included in the two indices.

For most services, it is clear why application of the three criteria led to their selection as specialized services. The rationale for the costliness weight is similarly clear for most services. For example, the cost implications of inpatient renal dialysis outweigh those of outpatient dialysis. However, the availability of outpatient dialysis usually connotes a more extensive facility than does inpatient dialysis alone. Confirming this point, no Segment III hospital provides only outpatient dialysis. It is therefore appropriate to assign weights of 3 and 1 respectively to inpatient dialysis and outpatient dialysis.

The substantive logic is more complex for intensive care units (ICUs), which are often considered specialized facilities. Emergency care, including reliance on intensive care units, has evolved rapidly during the last two decades. It is now a reasonable presumption that the great majority of hospitals have some type of intensive care unit. Corroborating this expectation, 90 Segment III institutions had either a mixed ICU or a cardiac ICU in 1973, making it evident that the presence of either such facility could not be regarded as a specialized service. In fact, because of the development and proliferation of intensive care techniques in recent years, it is now necessary to consider the presence of either of these facilities a basic hospital service. Accordingly, intensive care so defined is included in the basic service mix index, as indicated later in this chapter.

However, the presence of both mixed and cardiac intensive care units does indicate the presence of a specialized service. In this instance a hospital's provision of intensive care has progressed to the point where one unit is used for cardiac patients and another unit for other types of patients. The presence of a cardiac ICU and a mixed ICU is therefore included in the specialized service mix index. As shown in Table 19-8, this combined service was assigned a weight of 2.

Using the services specified in Table 19-8, the specialized services index was constructed according to the following formula.[19] The denominator of this index is the same for all study hospitals, equalling 22, i.e., the sum of the weights of the specialized services.

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[19] Some analysts have elected not to combine services into a single index, but rather to include in their analyses a number of dichotomous variables, i.e., one variable for each service. As with the case mix index, this approach was not utilized in this project because it is both operationally unwieldy and substantively confusing.

$$SSM_i = \left[\frac{\sum_{y=1}^{n} W_y S_{iy}}{\sum_{y=1}^{n} W_y} \right]_i ,$$

where SSM_i = Specialized services index for the i^{th} hospital

W_y = Costliness weight for the y^{th} service

S_{iy} = Dichotomous variable indicating the presence or absence of the y^{th} service in the i^{th} hospital

If a hospital offers all 12 specialized services, its value for this index is 1.0. If it provides none of these services, its value for this index is 0. The greater the number of specialized services offered by a hospital, the higher is its value for this index, especially if those services have high costliness weights. To illustrate the calculation of this index, if a hospital provides inpatient dialysis, premature nursery, x-ray therapy, and electroencephalography, its value for this index will be .32, i.e., the sum of the costliness weights for its four services (7) divided by the constant denominator of 22.

The basic services index represents the set of services required for hospitals to operate effectively as acute care institutions. However, if a service was offered by all or almost all Segment III hospitals, it was not included in this index. Its presence would be redundant since it would not contribute to variation in service mix among study hospitals. As an example, recovery room was excluded from the index for this reason.

Analogous to the specialized services index, weights indicating the importance of each basic service were developed for this index. These weights and the services included in the basic services index are shown in Table 19-9.[20] Each of these services satisfies the condition that during the study years a hospital would be expected to offer the service. While it might occasionally be appropriate for a specific hospital not to offer a particular basic service, it seems likely that the number of justifiable instances of this type is low. Accordingly, the great majority of hospitals should have all the basic services.

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[20] In a study using 1969 data, Neuhauser and Turcotte (1972) included most of this study's basic services in their set of basic services. Specifically, the basic services common to both studies are full-time pharmacist, histopathology laboratory, blood bank, and physical therapy.

Table 19-9

COMPONENTS OF BASIC SERVICES INDEX

Index Component	Importance
Pharmacy	
Full-time Pharmacist	2
Part-time Pharmacist	1
Laboratory	
Histopathology Laboratory	1
Blood Bank	1
Intensive Care	
Mixed ICU or Cardiac ICU	2
Support Services	
Inhalation Therapy	1
Physical Therapy	1

The formula for the basic services index, shown below, is the same as that for the specialized services index. The only structural difference between these indices is their composition in terms of services. Analogous to the specialized services index, the denominator for this index is constant across study hospitals, equalling 8 in this instance.[21]

$$BSM_i = \left[\frac{\sum_{y=1}^{n} W_y S_{iy}}{\sum_{y=1}^{n} W_y} \right]_i ,$$

where BSM_i = Basic services index for the i^{th} hospital

W_y = Weight indicating the importance of each service

S_{iy} = Dichotomous variable indicating the presence or absence of the y^{th} service in the i^{th} hospital

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[21] The denominator equals 8, rather than 9, because a hospital cannot accumulate more than eight basic services points since the two pharmacist services are mutually exclusive. For the same reason, the overall pharmacy component, rather than the two elements within the component, is used in the correlation findings described later.

Like the specialized services index, the potential range for this index is from 0 to 1.0. In actuality, each study hospital has at least one basic service, so that the minimum value for this index is .125 in 1970 and .25 in 1973. In contrast, many hospitals exhibit the maximum value of 1.0. To illustrate the calculation of this index, consider a hospital which has a full-time pharmacist, a histopathology laboratory, and physical therapy. The value of this index for this hospital is .50, i.e., the sum of the importance weights of its three services (4) divided by the constant denominator of 8.

Like several indices discussed earlier, each service in the specialized services index is intended to represent specialized service mix, i.e., the array of sophisticated services offered by hospitals. Similarly, each service in the basic services index is designed to stand for basic service mix, i.e., those services that should be provided by all or almost all hospitals. Accordingly, the correlation between each service mix index and each of its components should be significantly positive at least at the .05 level in a one tailed test (it should equal at least .17).

As shown in Table 19-10, this condition is easily satisfied by both indices in 1973. For the specialized service mix index, the component correlations range from .69 to .40. The former involves radium therapy and the latter organ bank. Three components are correlated at .73 with the basic services index: pharmacy, histopathology laboratory, and mixed or cardiac ICU. The lowest component correlation with this index is .39, which is exhibited by blood bank.

The findings in 1970 are similar. Radium therapy again exhibits the highest correlation with the specialized services index. However, the lowest correlation is displayed by open heart surgery, rather than by organ bank. The presence of an ICU has the highest correlation with the basic service mix index, while blood bank again has the lowest correlation with this index.

Like case severity and utilization practices, the two service mix indices are constructed according to the same formula but are intended to represent different endogenous variables. It is therefore important for each index component to be more highly correlated with its own index than with the other index. As also displayed in Table 19-10, this condition is satisfied by the components of these indices in 1973. The same finding holds in 1970. In the later study year the specialized service exhibiting the widest correlation difference is inpatient dialysis. It is correlated at .67 with its own index and at .23 with the basic services index. The specialized service displaying the least difference is diagnostic radioisotope facility, whose correlations with the specialized service mix and basic service mix indices are .62 and .57 respectively.

Table 19-10

CORRELATIONS OF 1973 SPECIALIZED SERVICES AND BASIC SERVICES INDICES WITH THEIR COMPONENTS

Specialized Services	Specialized Service Mix Index	Basic Service Mix Index
Mixed ICU and Cardiac ICU	.64	.44
Premature Nursery	.51	.30
Open-Heart Surgery	.61	.21
Organ Bank	.40	.15
Inpatient Dialysis	.67	.23
Outpatient Dialysis	.61	.21
X-Ray Therapy	.63	.51
Cobalt Therapy	.52	.32
Radium Therapy	.69	.46
Diagnostic Radioisotope Facility	.62	.57
Occupational Therapy	.50	.35
Electroencephalography	.60	.44
Basic Services		
Pharmacy	.39	.73
Histopathology Laboratory	.55	.73
Blood Bank	.15	.39
Mixed ICU or Cardiac ICU	.37	.73
Inhalation Therapy	.32	.55
Physical Therapy	.22	.54

The basic service showing the widest difference is mixed or cardiac ICU. Its correlations are .73 with its own index and .37 with the specialized services index. Histopathology laboratory is the basic service displaying the least difference. Its correlations with both indices are high, equalling .73 with the basic services index and .55 with the specialized services index.

Corroborating their substantive bases, the mean of the basic service mix index is much higher than that of the specialized service mix index. In 1973 the former equals .86 and the latter .26. In contrast, the degree of variation in these indices is similar. The standard deviation for the basic service mix index is .20, while that for the specialized services index is .22. Somewhat surprisingly, during the study years the percentage increase in basic service mix is greater than that in specialized service mix. The mean percentage increase in the former index is 16% compared to 9% for the latter.

As expected, the two service mix indices are positively associated. Their correlations are .56 in 1973 and .65 in 1970. However, the percentage changes in these variables are insignificantly associated. Despite the high correlations between these variables in both study years, their common variation is only 31% in 1973 and 42% in 1970. Hence, the distributions of these variables are strongly related but still distinctly different, which is consistent with their substantive bases.

The correlations of the service mix variables with the other endogenous variables are similar and follow the anticipated pattern. Both are strongly positively associated with quality. Both are positively correlated with case severity, and to a lesser extent, with length of stay and elective surgery. Neither is significantly associated with case mix, and both exhibit a strong negative correlation with elderly caseload.

20.
Effects on Case Intensity and Utilization Practices

This chapter employs the same format and techniques as those used in the analogous chapters of the two preceding sections. Both the overall results and the detailed findings of each set of analyses are described. As discussed in Chapter 18, with the exception of the special Michigan analyses, only the Combined analyses were conducted in this part of Segment III.

The first chapter topic is the case intensity findings, followed by a discussion of the utilization practices results. The chapter then describes the patient mix findings and closes with a review of the length of stay results.

Case Intensity

Overall Results

Findings -- It was hypothesized in Chapter 18 that the Indiana Program would have an insignificant impact on case mix in both study years, and on the percentage change in this variable. Similarly, the Program was expected to have insignificant effects on case severity and elective surgery.

These hypotheses are entirely supported by the findings, as shown in Table 20-1. The Program has an insignificant influence on case mix in both 1973 and 1970 and an insignificant impact on the percentage change in this variable. Likewise, the Program's effects on case severity and elective surgery are insignificant in all study time periods.

Table 20-1

IMPACT OF INDIANA PROGRAM ON CASE INTENSITY

	CASE MIX	CASE SEVERITY	ELECTIVE SURGERY
1973	0*	0	0
1970	0	0	0
% Δ	0	0	0

* If the impact of the Indiana Program is not significant at least at the .05 level, it is reported as a zero in this and similar tables in Section VI.

Interpretation -- The Program has an insignificant influence on all three case intensity variables. This finding is most important for case mix and case severity because they are fundamental measures of case intensity. As such, they exert an influence on cost, productivity, and other endogenous variables. By extension, in order to impact cost through case intensity, the Indiana Program must exert a sufficient influence on case intensity to affect case mix and case severity. Consequently, the implication of the case mix and case severity findings is that the Program's impact on cost is not produced even partially through an effect on case intensity. Similarly, the Program's effects on labor productivity, average salary, and supply/service cost do not arise from an impact on case intensity.

The elective surgery results are also important, but for a different reason. The Program creates a set of incentives for hospitals to shift toward high ancillary, low nursing intensity care -- a category characterizing most elective surgery patients. Because of their easy identifiability, the frequency of elective surgery cases is potentially manipulable by hospitals. Yet, in spite of these considerations, the Program still exerts an insignificant influence on this variable. Coupled with the case mix and case severity results, this finding thus makes it unlikely that the Indiana Program has any systematic effect on case intensity even in ways not explicitly measured in this study. Hence, in terms of the types of cases treated, these analyses show that the Indiana Program does not influence the nature of hospital output.

Detailed Findings

The predictive power of the case intensity annual analyses is substantial, although not high. As shown in Table 20-2, it is greatest in the case severity equations where the R^2s approximate .42. Predictive power is intermediate in the elective surgery analyses with the R^2s approximating .30. It is lowest in the case mix equations, where the R^2 equals .25 in 1973 and .16 in 1970.

Collinearity involving the Indiana Program is extremely low. The Program's covariance ratio never exceeds .03. Overall collinearity is modest with the determinant at .55 in the 1973 case mix equation and never lower than .80 in the other five equations.

The Program's impact on case severity is positive and almost significant at the .05 level in both 1973 and 1970. Its influence on case mix is also positive and significant at the .10 level in 1970, although the t-value in the case mix equation is lower than in the case severity equation in 1970 (1.40 versus 1.62). In 1973 the Program's effect on case mix continues to be positive, but is narrowly insignificant at the .10 level. In contrast to its effects on case mix and case severity, the Program's influence on elective surgery is negative. Its impact is significant at the .10 level in 1970, but is narrowly insignificant at that level in 1973.

Table 20-2

ANNUAL ANALYSES OF CASE INTENSITY

	CASE MIX		CASE SEVERITY		ELECTIVE SURGERY	
	1973	1970	1973	1970	1973	1970
Indiana Program						
coefficient	16×10^{-3}	20×10^{-3}	41×10^{-3}	37×10^{-3}	-54×10^{-3}	-57×10^{-3}
t-value	1.28	1.40	1.58	1.62	-1.27	-1.53
% impact	1.6	1.9	4.5	4.0	-5.6	-5.9
covariance	0.03	0.03	0.01	0.01	0.00	0.01
Emergency/Outpatient						
coefficient					90×10^{-2}	17×10^{-1}
t-value					1.82	3.05
Bed Size						
coefficient			34×10^{-5}	39×10^{-5}	32×10^{-5}	20×10^{-5}
t-value			3.90	4.93	2.50	1.70
White Population						
coefficient	-17×10^{-2}		-83×10^{-2}	-66×10^{-2}		
t-value	-2.10		-4.70	-4.30		
Pediatric Population						
coefficient	-24×10^{-1}	-33×10^{-1}				
t-value	-2.78	-4.34				
Elderly Population						
coefficient	61×10^{-2}				-39×10^{-1}	-33×10^{-1}
t-value	1.89				-4.36	-4.25
R^2	0.25	0.16	0.41	0.43	0.30	0.31
Determinant	0.55	0.97	0.80	0.82	0.89	0.88
Constant	13×10^{-1}	13×10^{-1}	16×10^{-1}	15×10^{-1}	12×10^{-1}	11×10^{-1}

Case severity has two strong determinants. One is bed size which has a positive impact; the other is white population which has a negative influence. The most powerful determinant of case mix is pediatric population which has a negative influence. There is no other determinant of this variable in 1970, but in 1973 white population has a negative impact and elderly population a positive influence. Elective surgery has three consistent determinants. The strongest is elderly population which has a negative impact. The other two are bed size and emergency/outpatient involvement, both of which have positive effects.

As shown in Table 20-3, the predictive power of the case intensity percentage change analyses is low. The R^2s range from .07 in the elective surgery equation to .04 in the case mix comparison. Two factors are largely responsible for this result. First, the case intensity variables did not change to an appreciable degree. The average

percentage change during the study period is less than 1% for each variable. Second, some of the important determinants in the annual analyses are Census variables, for which it is not possible to construct percentage change measures.

Table 20-3

PERCENTAGE CHANGE ANALYSES OF CASE INTENSITY

	CASE MIX	CASE SEVERITY	ELECTIVE SURGERY
Indiana Program			
coefficient	-30×10^{-4}	16×10^{-5}	14×10^{-3}
t-value	-0.34	0.01	0.49
% impact	-257.3	7.8	122.0
covariance	0.00	0.01	0.05
% Δ MD Concentration			
coefficient			36×10^{-2}
t-value			2.83
MD Concentration			
coefficient		58×10^{-5}	
t-value		1.79	
White Population			
coefficient	-11×10^{-2}		
t-value	-1.95		
Education			
coefficient		-38×10^{-3}	
t-value		-1.74	
R^2	0.04	0.05	0.07
Determinant	1.00	0.89	0.95
Constant	98×10^{-3}	42×10^{-2}	-14×10^{-3}

The single determinant of the percentage change in elective surgery is the percentage change in physician concentration which has a positive impact. Education level has a negative influence on the percentage change in case severity, while physician concentration has a positive effect on this variable. The only determinant of the percentage change in case mix is white population, which has a negative impact. Reflecting the few determinants, collinearity is extremely low in these equations. The Program's covariance ratio is never higher than .05 and the determinant is never lower than .89.

Unlike the case intensity annual equations, where the Program's effect is often significant at the .10 level (although never at the .05 level), the Program's influence in these equations is thoroughly insignificant. Its highest t-value is .49 in the elective surgery equation.

Utilization Practices

Overall Results

Findings -- It was anticipated that the Program would have an insignificant influence on utilization practices in both 1973 and 1970. Correspondingly, an insignificant effect on the percentage change in this factor was expected.

These hypotheses are largely supported by the findings. As displayed in Table 20-4, in 1973 the Program has an insignificant impact on utilization practices. The same holds for the percentage change in this variable. However, in 1970 the Program exerts a +6% impact on utilization practices.

Table 20-4

IMPACT OF INDIANA PROGRAM ON UTILIZATION PRACTICES

	UTILIZATION PRACTICES
1973	0
1970	+6%
% Δ	0

It is thus possible that the Program influences cost in 1970 through utilization practices. To assess this possibility it is necessary to determine the impact of utilization practices on cost. That is, it is necessary to conduct Step C cost analyses similar to those discussed in depth in Chapter 13, but also employed in Segment II. These analyses show the effects of endogenous variables on cost, taking into account other endogenous variables and semi-exogenous variables.

In these Step C analyses utilization practices has an insignificant impact on total cost in 1970. The Indiana Program thus does not influence cost through its impact on utilization practices in that year. In addition, the Step C results show that utilization practices also has an insignificant effect on cost in the 1973 and percentage change analyses.

It was hypothesized that in the special Michigan analyses the Indiana Program would have insignificant effects on case mix, case severity, and utilization practices in both study years, and on the percentage changes in these variables.

These expectations are fully supported by the findings. As displayed in Table 20-5, the Indiana Program, and thus the Michigan program, has an insignificant influence on these variables in both study years, and on the percentage change in these variables.

Table 20-5

IMPACT OF INDIANA PROGRAM IN SPECIAL MICHIGAN ANALYSES

	CASE MIX	CASE SEVERITY	UTILIZATION PRACTICES
1973	0	0	0
1970	0	0	0
% Δ	0	0	0

Interpretation -- The central finding of these analyses is that the Indiana Program has an insubstantial influence on utilization practices. Its impact on this variable in 1973 and on the percentage change in utilization practices is insignificant. It does have a positive effect in 1970, but this effect is relatively modest. More important, utilization practices does not have a significant influence on cost, which means that this is not a mechanism through which the Indiana Program influences cost.

The findings of the special Michigan analyses unequivocally support the analytical approach taken in Segment III. The Michigan program does not significantly influence case mix, case severity, or utilization practices in any of the study time periods. These findings substantiate the hypothesis that the Michigan program does not influence physician-dominated variables.

Detailed Findings

As shown in Table 20-6, the predictive power of the utilization practices annual analyses is modest, with the R^2 equalling .11 in the 1973 equation and .19 in the 1970 analysis. Collinearity involving the Indiana Program is low. The Program's covariance ratio is .01 in the 1973 analysis and .05 in the 1970 comparison. Overall collinearity is minimal in the 1973 equation, and substantial, although not high, in the 1970 analysis. The determinant equals .99 in the former and .41 in the latter.

In the 1970 equation the Program's positive influence on utilization practices is narrowly significant at the .01 level. In the 1973

comparison its influence is also positive, but is only significant at the .10 level. In this equation its percentage impact is +4%.

Table 20-6

ANNUAL ANALYSES OF UTILIZATION PRACTICES

	UTILIZATION PRACTICES	
	1973	1970
Indiana Program coefficient	44×10^{-3}	66×10^{-3}
t-value	1.58	2.44
% impact	4.3	6.4
covariance	0.01	0.05
Bed Size coefficient		-21×10^{-5}
t-value		-2.07
Nonprofit Control coefficient		78×10^{-3}
t-value		2.65
White Population coefficient		-41×10^{-2}
t-value		-2.12
Farm coefficient		41×10^{-2}
t-value		1.96
Education coefficient	-74×10^{-3}	
t-value	-2.97	
R^2	0.11	0.19
Determinant	0.99	0.41
Constant	19×10^{-1}	14×10^{-1}

The 1970 equation contains four determinants besides the Indiana Program. Bed size and white population have a negative influence on utilization practices in that year, while nonprofit control and farm population have a positive impact. In 1973 the single determinant of utilization practices is education level which has a negative impact.

Unlike many study variables, the predictive power of the utilization practices percentage change analysis is approximately as high as that of the annual analyses. As indicated in Table 20-7, the R^2 equals .13. Collinearity involving the Indiana Program is low, with the Program's covariance ratio equalling .03. Overall collinearity is moderate; the determinant equals .66.

Table 20-7

PERCENTAGE CHANGE ANALYSIS OF UTILIZATION PRACTICES

	UTILIZATION PRACTICES
Indiana Program	
coefficient	-11×10^{-3}
t-value	-0.57
% impact	-307.1
covariance	0.03
Nonprofit Control	
coefficient	-67×10^{-3}
t-value	-3.20
Farm	
coefficient	-37×10^{-2}
t-value	-2.76
Education	
coefficient	-47×10^{-3}
t-value	-2.40
R^2	0.13
Determinant	0.66
Constant	64×10^{-2}

In accord with the annual analyses, the Program has a negative influence on the percentage change in utilization practices. However, this influence is clearly insignificant. There are three determinants of the percentage change in utilization practices -- nonprofit control, farm population, and education level. Each has a negative impact on this percentage change variable.

The predictive power of the special Michigan annual analyses is moderately higher than that of the analogous Combined annual analyses. As shown in Table 20-8, the R^2s are again highest in the case severity equations, approximating .42. Like their Combined counterparts, collinearity involving the Indiana Program is low in these Michigan analyses. The Program's covariance ratio never exceeds .12. Overall collinearity also does not present an analytical problem. The determinant never falls below .44.

The Program's impact on case mix is positive. It is significant at the .10 level in 1970; it is insignificant at that level in 1973. In partial contrast, the Program's influence on case severity is thoroughly insignificant in both study years. The Program's effect on utilization practices is positive, but modestly insignificant at the .10 level in both 1973 and 1970.

Table 20-8

SPECIAL MICHIGAN ANNUAL ANALYSES

	CASE MIX		CASE SEVERITY		UTILIZATION PRACTICES	
	1973	1970	1973	1970	1973	1970
Indiana Program						
coefficient	15×10^{-3}	23×10^{-3}	-25×10^{-3}	35×10^{-4}	37×10^{-3}	38×10^{-3}
t-value	1.12	1.40	-0.85	0.14	1.19	1.25
% impact	1.6	2.3	-2.5	0.4	3.5	3.7
covariance	0.02	0.01	0.12	0.07	0.04	0.12
ECF Involvement						
coefficient			-56×10^{-2}			
t-value			-2.09			
Emergency/Outpatient						
coefficient						-15×10^{-1}
t-value						-3.15
Bed Size						
coefficient			39×10^{-5}	35×10^{-5}	-25×10^{-5}	-36×10^{-5}
t-value			3.42	3.52	-2.25	-3.57
White Population						
coefficient	-25×10^{-2}		-62×10^{-2}	-59×10^{-2}		
t-value	-2.82		-3.29	-3.55		
Education						
coefficient					-74×10^{-3}	
t-value					-2.19	
Pediatric Population						
coefficient	-26×10^{-1}	-37×10^{-1}				
t-value	-2.27	-3.22				
Elderly Population						
coefficient	99×10^{-2}		17×10^{-1}			
t-value	2.46		2.09			
R^2	0.32	0.14	0.44	0.41	0.18	0.28
Determinant	0.63	0.99	0.44	0.73	0.86	0.88
Constant	14×10^{-1}	13×10^{-1}	13×10^{-1}	14×10^{-1}	20×10^{-1}	12×10^{-1}

The determinants of case mix are the same in these equations as in the Combined analyses. That is, pediatric population has a negative influence in both study years, while white population has a negative impact and elderly population a positive influence in 1973. Like the Combined analyses, the two strongest determinants of case severity are bed size and white population, which respectively have positive and negative effects. In addition, in the 1973 equation elderly population has a positive influence and ECF involvement has a negative impact. Bed size has a negative influence on utilization practices in both study years. As in the Combined analyses, education level has a negative impact in the 1973 equation. Emergency/outpatient involvement has a negative effect in the 1970 equation.

The predictive power of the special Michigan percentage change analyses is also somewhat higher than that of the corresponding Combined analyses. As indicated in Table 20-9, the R^2 equals .21 in the utilization practices equation, and approximates .10 in the other two equations. Collinearity involving the Indiana Program is very low, with the Program's covariance ratio never rising above .06. Overall collinearity ranges substantially in these equations, but still does not pose analytical difficulties. The determinant is never lower than .29.

Table 20-9

SPECIAL MICHIGAN PERCENTAGE CHANGE ANALYSES

	CASE MIX	CASE SEVERITY	UTILIZATION PRACTICES
Indiana Program			
coefficient	-39×10^{-4}	-18×10^{-3}	-80×10^{-4}
t-value	-0.38	-0.67	-0.38
% impact	-136.5	-90.8	-112.1
covariance	0.06	0.01	0.06
Nonprofit Control			
coefficient			-83×10^{-3}
t-value			-3.32
MD Concentration			
coefficient		80×10^{-5}	
t-value		2.14	
Income			
coefficient	17×10^{-6}		
t-value	2.46		
Farm			
coefficient			-49×10^{-2}
t-value			-2.79
Education			
coefficient		-72×10^{-3}	-81×10^{-3}
t-value		-2.41	-3.27
Elderly Population			
coefficient	97×10^{-2}		
t-value	2.21		
R^2	0.09	0.10	0.21
Determinant	0.29	0.87	0.61
Constant	-26×10^{-2}	82×10^{-2}	11×10^{-1}

The Program's influence is thoroughly insignificant in these analyses. Its highest t-value is -.67 in the case severity equation.

The determinants in the utilization practices equation are the same as those in the Combined analysis: nonprofit control, farm population, and education level, all with negative effects. Similarly, the case severity equation includes the same two determinants as the corresponding Combined equation: physician concentration which has a positive impact, and education level which has a negative influence. In contrast, the determinants of the percentage change in case mix are different, with income level and elderly population having positive effects in this analysis.

Patient Mix

Overall Results

Findings -- It was anticipated that the Indiana Program would have an insignificant influence on elderly caseload in both study years, and on the percentage change in this variable. The same hypothesis was developed for white caseload.

These expectations are fully corroborated by the results. As indicated in Table 20-10, the Indiana Program does not have a significant influence on either patient mix variable in either study year. Similarly, it has an insignificant impact on the percentage changes in these variables.

Table 20-10

IMPACT OF INDIANA PROGRAM ON PATIENT MIX

	ELDERLY CASELOAD	WHITE CASELOAD
1973	0	0
1970	0	0
% Δ	0	0

Interpretation -- The patient mix findings have three significant implications. First, they indicate the absence of a possible pathway for the Program's impact on cost. That is, they show that the cost-reducing effect of the Program is not achieved even in part by modifying patient mix. Second, they demonstrate that the Indiana Program does not induce hospitals to inappropriately discriminate among their patients on the basis of age and race. By extension, it is likely that the Program does not create inappropriate discrimination on the basis of other patient characteristics. Third, these results are important from a methodologic perspective. By demonstrating the Program's insignificant influence

on elderly caseload, they substantiate the use of this variable as a Type B semi-exogenous variable in Segments I and II.

Detailed Findings

The predictive power of the patient mix annual analyses is shown in Table 20-11. It is much higher in the elderly caseload equations than in the white caseload analyses. The R^2s approximate .60 in the former and .20 in the latter. Collinearity involving the Indiana Program is low, with the Program's covariance ratio never exceeding .07. Overall collinearity is substantial, but not high, in the 1973 elderly caseload equation. The determinant equals .28 in this equation; it is never lower than .50 in the other three comparisons.

Table 20-11

ANNUAL ANALYSES OF PATIENT MIX

	ELDERLY CASELOAD		WHITE CASELOAD	
	1973	1970	1973	1970
Indiana Program				
coefficient	10×10^{-4}	11×10^{-3}	59×10^{-5}	00×10^{0}
t-value	0.09	0.82	0.05	0.00
% impact	0.3	3.1	0.1	0.0
covariance	0.07	0.07	0.03	0.03
Bed Size				
coefficient	-22×10^{-5}	-21×10^{-5}	-74×10^{-5}	-83×10^{-5}
t-value	-5.69	-4.48	-2.29	-2.35
Income				
coefficient	-16×10^{-6}			
t-value	-2.20			
Farm				
coefficient		23×10^{-2}	14×10^{-2}	12×10^{-2}
t-value		2.19	2.18	1.78
Elderly Population				
coefficient	12×10^{-1}	15×10^{-1}		
t-value	3.15	5.36		
R^2	0.61	0.57	0.21	0.18
Determinant	0.28	0.50	0.68	0.68
Constant	45×10^{-2}	22×10^{-2}	95×10^{-2}	96×10^{-2}

The influence of the Indiana Program is thoroughly insignificant in these analyses. Its highest t-value (.82) occurs in the 1970 elderly caseload equation. In the other three analyses its t-value never exceeds .09.

The two strongest determinants of elderly caseload are elderly population and bed size. The former has a positive effect and the latter a

negative impact. In addition, farm population has a positive influence on 1970 elderly caseload, and income level has a negative impact on 1973 elderly caseload. Bed size also has a negative effect on white caseload. The other determinant of this variable is farm population which has a positive impact.

The predictive power of the patient mix percentage change analyses is low. The R^2 in the elderly caseload equation equals .08, as displayed in Table 20-12. There are no significant determinants in the white caseload equation, and thus the R^2 is zero. One factor contributing to this result is that white caseload changed very little during the study years. The mean of this percentage change variable approximates zero, and its standard deviation is substantially lower than those of the other percentage change measures used as endogenous variables in this segment.

Table 20-12

PERCENTAGE CHANGE ANALYSES OF PATIENT MIX

	ELDERLY CASELOAD	WHITE CASELOAD
Indiana Program coefficient	-14×10^{-3}	12×10^{-4}
t-value	-0.66	0.40
% impact	-24.1	125.8
covariance	0.01	0.00
Medical Education coefficient	12×10^{-1}	
t-value	2.85	
R^2	0.08	0.00
Determinant	0.99	1.00
Constant	46×10^{-3}	-93×10^{-5}

The influence of the Indiana Program is thoroughly insignificant in both equations. The single determinant of the percentage change in elderly caseload is medical education involvement, which has a positive impact. In the elderly caseload equation collinearity is minimal. The Program's covariance ratio is .01 and the determinant is .99.

Length of Stay

Overall Results

Findings -- It was hypothesized that the Program would have an insignificant impact on length of stay in 1973 and 1970. Accordingly, it

was expected that the Program's effect on the percentage change in length of stay would be insignificant.

The findings fully confirm these hypotheses. As displayed in Table 20-13, the Indiana Program has an insignificant effect on length of stay in both study years. Its influence on the percentage change in this variable is also insignificant.

Table 20-13

IMPACT OF INDIANA PROGRAM ON LENGTH OF STAY

	LENGTH OF STAY
1973	0
1970	0
% Δ	0

Interpretation -- Length of stay reflects the influence of case intensity, utilization practices, and patient mix. Specifically, as described in Chapter 19, this variable is most strongly influenced by case severity and case mix. It is also affected by utilization practices, elderly caseload, and white caseload. The analysis of length of stay thus provides a concise summary of the other analyses discussed in this chapter. Accordingly, given the findings of those analyses, it is not surprising that the Indiana Program has an insignificant influence on length of stay.

Like elderly caseload, length of stay is used as a semi-exogenous variable in Segments I and II. Unlike elderly caseload, length of stay has a strong effect on total cost. It is therefore essential to test whether the Program has a significant influence on length of stay. By showing that the Program's impact on this variable is insignificant in all Segment III time periods, these analyses substantiate the use of length of stay as a semi-exogenous variable in the earlier segments.[1]

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[1] In a supplementary analysis case severity and case mix were substituted as independent variables for length of stay in the total cost equations. Reflecting the Program's insignificant effects on all three variables and the strong influence of case severity and case mix on length of stay, the Program's impact on total cost is not appreciably affected by this substitution. For example, in the 1973 supplementary equation the Program's percentage impact on total cost is -10% and its dollar impact is -$81 per case.

A strong implication emerges from the findings discussed in this chapter. They indicate that the Indiana Program achieves its cost-reducing effect not by affecting the kinds of patients treated by hospitals, but by influencing certain administrator-dominated variables. Taking into account other factors, labor productivity is higher in Indiana hospitals; average salary is lower; wage level and skill mix are lower; and supply/service cost is lower. At the same time, the physician-controlled variables are essentially unchanged: Case mix, case severity, elective surgery, elderly caseload, and white caseload are all insignificantly affected. Utilization practices is significantly impacted, but only in 1970. Encapsulating these results, length of stay, traditionally a central indicator of hospital operations, is not significantly influenced by the Program.

Detailed Findings

The predictive power of the length of stay annual analyses is moderate, and similar to that of the other annual analyses reviewed in this chapter. As shown in Table 20-14, the R^2 equals .34 in the 1973 equation and .19 in the 1970 analysis. Collinearity is low in these equations. The Program's covariance ratio equals .02 in both equations; the determinant is never lower than .70.

Table 20-14

ANNUAL ANALYSES OF LENGTH OF STAY

	LENGTH OF STAY	
	1973	1970
Indiana Program		
coefficient	30×10^{-2}	26×10^{-2}
t-value	1.34	1.16
% impact	4.0	3.4
covariance	0.02	0.02
ECF Involvement		
coefficient	-39×10^{-1}	-48×10^{-1}
t-value	-1.83	-1.71
MD Concentration		
coefficient	59×10^{-4}	52×10^{-4}
t-value	2.22	1.73
White Population		
coefficient	-75×10^{-1}	-45×10^{-1}
t-value	-5.40	-3.14
Elderly Population		
coefficient	15×10^{0}	13×10^{0}
t-value	3.13	2.71
R^2	0.34	0.19
Determinant	0.70	0.75
Constant	13×10^{0}	10×10^{0}

The Program has a positive influence on length of stay in both years. In 1973 its effect is narrowly significant at the .10 level; in 1970 it is insignificant at that level.

The strongest determinant of length of stay is white population, which has a negative impact. Both elderly population and physician concentration have positive effects on this variable. The remaining determinant is ECF involvement, which has a negative influence.

The length of stay percentage change analysis is shown in Table 20-15. The predictive power of this equation is moderate; its R^2 is .20. Collinearity is low, with the Program's covariance ratio equalling .03 and the determinant .80.

Table 20-15

PERCENTAGE CHANGE ANALYSIS OF LENGTH OF STAY

	LENGTH OF STAY
Indiana Program	
coefficient	-48×10^{-5}
t-value	-0.03
% impact	-1.3
covariance	0.03
ECF Involvement	
coefficient	-36×10^{-2}
t-value	-1.75
MD Concentration	
coefficient	50×10^{-5}
t-value	2.06
White Population	
coefficient	-34×10^{-2}
t-value	-3.18
Education	
coefficient	-33×10^{-3}
t-value	-1.99
R^2	0.20
Determinant	0.80
Constant	63×10^{-2}

The Program's influence is thoroughly insignificant. Its t-value equals -.03. Consistent with the annual analyses, white population and ECF involvement have a negative influence on the percentage change in length of stay; and physician concentration has a positive impact. The other determinant is education level which has a negative effect.

21.
Effects on Quality and Service Mix

The previous chapter discusses a series of variables, most of which are closely related to length of stay. The subjects of this chapter -- quality and service mix -- are more distant from length of stay, but are as important as the topics of Chapter 20. The chapter opens by discussing the quality results and closes by describing the service mix findings. In accord with Chapter 18, only the Combined control group is employed in the quality area, while all three control groups are included in the service mix analyses.

Quality

Overall Results

Findings -- It was hypothesized that the Indiana Program would have an insignificant impact on quality in 1973 and 1970. It was also expected that its influence on the percentage change in this variable would be insignificant.

The results fully confirm these hypotheses. As displayed in Table 21-1, the Program's impact on quality is insignificant in both study years as is its effect on the percentage change in this variable.

Table 21-1

IMPACT OF INDIANA PROGRAM ON QUALITY

	QUALITY
1973	0
1970	0
% Δ	0

Interpretation -- The quality findings are extremely important. They indicate that the Indiana Program is able to reduce cost without affecting the quality of care. On the one hand, the Program has induced hospitals to make major changes in the utilization of resources,

especially in labor usage, but also in supply/service usage. On the other hand, the Program has not significantly influenced patient management. Such management does not appear to be materially different in Indiana hospitals than in control hospitals, in terms of either quality or case intensity.

Detailed Findings

The predictive power of the quality annual analyses is solid, although not high. As shown in Table 21-2, the R^2 is .41 in the 1970 equation and .27 in the 1973 analysis. Collinearity involving the Indiana Program is low; the Program's covariance ratio is .05 in both equations. Overall collinearity is moderate, with the determinant equalling .69 and .50 respectively in the 1973 and 1970 equations.

Table 21-2

ANNUAL ANALYSES OF QUALITY

	QUALITY	
	1973	1970
Indiana Program		
coefficient	-70×10^{-4}	20×10^{-4}
t-value	-0.24	0.07
% impact	-0.7	0.2
covariance	0.05	0.05
ECF		
coefficient	-58×10^{-2}	
t-value	-2.20	
Bed Size		
coefficient		30×10^{-5}
t-value		2.67
Nonprofit Control		
coefficient	55×10^{-3}	57×10^{-3}
t-value	1.75	1.76
MD Concentration		
coefficient	10×10^{-4}	11×10^{-4}
t-value	2.80	2.76
Farm		
coefficient	-34×10^{-2}	-54×10^{-2}
t-value	-1.70	-2.47
R^2	0.27	0.41
Determinant	0.69	0.50
Constant	88×10^{-2}	78×10^{-2}

The influence of the Indiana Program is highly insignificant. Its t-value is -.24 in the 1973 equation and .07 in the 1970 comparison.

Physician concentration has a strong positive influence on quality in both 1973 and 1970. Nonprofit control also has a positive effect, while farm population has a negative influence. Bed size has a positive impact but only in the 1970 equation, whereas ECF involvement has a negative influence which is confined to the 1973 comparison.

As with other Segment III variables, the predictive power of the quality percentage change analysis is modest. The R^2 is .14, as indicated in Table 21-3. As in the annual equations, the impact of the Indiana Program is thoroughly insignificant. Bed size which has a negative impact is the only determinant of this percentage change variable. Collinearity is nonexistent in this equation. The Program's covariance ratio is .00 and the determinant is 1.00.

Table 21-3

PERCENTAGE CHANGE ANALYSIS OF QUALITY

	QUALITY
Indiana Program	
coefficient	58×10^{-4}
t-value	0.25
% impact	16.1
covariance	0.00
Bed Size	
coefficient	-29×10^{-5}
t-value	-4.12
R^2	0.14
Determinant	1.00
Constant	97×10^{-3}

Service Mix

Overall Results

Findings -- It was expected that the Indiana Program would have an insignificant influence on specialized service mix in both study years. It was further hypothesized that its impact on the percentage change in this variable would be insignificant and that these insignificant effects would characterize the Michigan and Tristate findings as well as the Combined results.

The findings substantiate these hypotheses. As shown in Table 21-4, in the Combined analyses the Indiana Program has an insignificant influence on specialized service mix in both 1973 and 1970. It also has an insignificant effect on the percentage change in this variable. The same findings apply to the Michigan and Tristate analyses.

Table 21-4

IMPACT OF INDIANA PROGRAM ON SPECIALIZED SERVICE MIX

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1970	0	0	0
% Δ	0	0	0

It was hypothesized that the Indiana Program would have an insignificant impact on basic service mix in 1973 and 1970. Accordingly, it was anticipated that it would have an insignificant influence on the percentage change in this variable. These effects were expected in the Michigan, Tristate, and Combined analyses.

The findings also fully confirm these hypotheses. As displayed in Table 21-5, the Program has an insignificant influence on basic service mix in both study years as well as on the percentage change in this variable in the Combined, Michigan, and Tristate analyses.

Table 21-5

IMPACT OF INDIANA PROGRAM ON BASIC SERVICE MIX

	COMBINED	MICHIGAN	TRISTATE
1973	0	0	0
1970	0	0	0
% Δ	0	0	0

Interpretation -- These findings complete the picture depicted by the earlier Segment III analyses. Not only do Indiana hospitals treat the same kinds of patients and provide the same quality of care as do control hospitals, but they also offer the same types of services. There is no suggestion that the Indiana Program forces hospitals to curtail services below the essential minimum. Similarly, specialized services

are as available in Indiana as they are in the control areas. While this may or may not be desirable from a capital allocation perspective, it does mean that the Indiana Program does not impact cost by affecting specialized service mix. If such an effect were present, it would suggest that the Indiana Program partially affects cost by changing the nature of hospital output. Instead, these findings support the conclusion derived earlier that the Indiana Program reduces cost but does not alter the nature of output.

These results further substantiate the analytical approach taken in this segment. Service mix is the Segment III variable that should be most sensitive to planning programs. Yet the Michigan planning program exerts an insignificant influence on both specialized service mix and basic service mix.

Among others, Bauer and Clark (1974) point out that the prevalence of general practitioners is higher in Indiana than in many other states. They suggest that lower hospital costs in Indiana may be partially attributable to this fact. Since general practitioner concentration is an exogenous variable explicitly taken into account in this study, it is unlikely that the cost differences attributed by the analyses to the Indiana Program are in fact partially due to the prevalence of general practitioners.

The Segment III results make this possibility even more remote. For a cost decrease to flow through general practitioner prevalence, it would be necessary for such variables as specialized service mix and case severity to be affected. As noted, neither these variables nor the other case intensity and service mix variables are significantly influenced by the Program.

Detailed Findings

The predictive power of the specialized service mix annual analyses is high, as shown in Table 21-6. The R^2s approximate .75, ranging from .78 in the 1970 Michigan equation to .68 in the 1973 Tristate comparison. Collinearity involving the Indiana Program is low. The Program's covariance ratio is .15 in the 1973 Michigan comparison; it never exceeds .06 in the other five equations. Overall collinearity is moderate, with the determinant ranging from .98 to .42.

The influence of the Indiana Program is clearly insignificant in all six equations. Its highest t-value occurs in the 1970 Tristate equation, but is only .77.

Bed size is the strongest determinant of specialized service mix, exhibiting a powerful positive influence in all six equations. Physician concentration also has a substantial positive effect, as does medical education involvement. The remaining determinant is white population which has a positive influence largely confined to 1973.

and length of stay have positive and negative effects respectively in the 1973 Combined and Tristate equations.

Table 16-26

ANNUAL ANALYSES OF SKILL MIX

	COMBINED		MICHIGAN		TRISTATE	
	1973	1968	1973	1968	1973	1968
Indiana Program						
coefficient	-52×10^{-3}	-35×10^{-3}	-13×10^{-3}	-83×10^{-5}	-51×10^{-3}	-54×10^{-3}
t-value	-3.54	-2.30	-0.68	-0.04	-3.30	-3.39
% impact	-3.6	-2.5	-0.9	-0.1	-3.6	-3.8
covariance	0.08	0.06	0.06	0.05	0.18	0.13
Length of Stay						
coefficient	-19×10^{-3}				-27×10^{-3}	
t-value	-2.82				-3.04	
ECF						
coefficient	-37×10^{-2}	-23×10^{-2}	-46×10^{-2}		-25×10^{-2}	-32×10^{-2}
t-value	-3.00	-2.07	-2.29		-1.99	-2.95
Bed Size						
coefficient	10×10^{-5}				10×10^{-5}	
t-value	2.00				1.91	
Medical Education						
coefficient			61×10^{-2}	71×10^{-2}		
t-value			2.19	1.70		
Income						
coefficient	22×10^{-6}	19×10^{-6}	15×10^{-6}	17×10^{-6}	27×10^{-6}	18×10^{-6}
t-value	3.48	3.02	1.67	1.96	3.85	2.42
Education						
coefficient		35×10^{-3}				31×10^{-3}
t-value		2.24				1.87
R^2	0.42	0.30	0.37	0.22	0.47	0.37
Determinant	0.49	0.74	0.61	0.71	0.39	0.65
Constant	13×10^{-1}	79×10^{-2}	12×10^{-1}	12×10^{-1}	13×10^{-1}	88×10^{-2}

The predictive power of the skill mix percentage change analyses is low, as it is in the wage level percentage change analyses. As shown in Table 16-27, the R^2 ranges narrowly from .17 to .09. Collinearity is low in these equations, with the Program's covariance ratio never exceeding .05 and the determinant never falling below .73.

In all three comparisons the influence of the Indiana Program is negative, and in the Combined and Michigan equations it is clearly insignificant. In contrast, in the Tristate equation the influence of the Program is almost significant at the .05 level.

Table 21-7

PERCENTAGE CHANGE ANALYSES OF SPECIALIZED SERVICE MIX

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-59×10^{-3}	-20×10^{-3}	-13×10^{-2}
t-value	-0.56	-0.16	-1.16
% impact	-55.9	-26.3	-77.6
covariance	0.04	0.17	0.17
Emergency/Outpatient			
coefficient	36×10^{-1}	46×10^{-1}	52×10^{-1}
t-value	2.28	2.28	2.44
Church			
coefficient	24×10^{-2}	26×10^{-2}	32×10^{-2}
t-value	2.09	1.67	2.79
MD Concentration			
coefficient	43×10^{-4}	49×10^{-4}	
t-value	2.97	3.13	
Farm			
coefficient	14×10^{-1}	20×10^{-1}	29×10^{-1}
t-value	2.03	2.30	3.31
Pediatric Population			
coefficient			-32×10^{0}
t-value			-3.84
Elderly Population			
coefficient			-17×10^{0}
t-value			-4.26
R^2	0.15	0.21	0.34
Determinant	0.73	0.60	0.22
Constant	-69×10^{-2}	-92×10^{-2}	40×10^{-1}

The predictive power of the basic service mix annual analyses is substantial, but not as high as that of the specialized service mix annual analyses. As indicated in Table 21-8, the R^2s range from .57 to .38, approximating .50. Collinearity involving the Indiana Program is modest, with the covariance ratio never exceeding .17. Overall collinearity is moderate; the determinant ranges from .88 to .38.

The effects of the Indiana Program are highly insignificant in all the equations. The highest t-value, .95, occurs in the 1970 Michigan comparison.

Bed size is the most consistent determinant of basic service mix, although its influence is not as strong on this variable as on specialized service mix. Physician concentration has a positive impact on basic service mix as it does on specialized service mix. Farm population, which is not a determinant of specialized service mix, has a negative impact on this service mix variable. Nonprofit control has a positive

influence, although only in the Tristate equations. The remaining determinant is elderly population which has a negative effect in the 1970 Michigan comparison.

Table 21-8

ANNUAL ANALYSES OF BASIC SERVICE MIX

	COMBINED		MICHIGAN		TRISTATE	
	1973	1970	1973	1970	1973	1970
Indiana Program						
coefficient	21×10^{-4}	13×10^{-3}	33×10^{-3}	43×10^{-3}	22×10^{-3}	20×10^{-3}
t-value	0.06	0.32	0.84	0.95	0.59	0.44
% impact	0.2	1.7	3.9	5.7	2.6	2.4
covariance	0.01	0.04	0.16	0.17	0.04	0.04
Bed Size						
coefficient	64×10^{-5}	86×10^{-5}	49×10^{-5}	67×10^{-5}	29×10^{-5}	49×10^{-5}
t-value	5.99	5.73	3.09	3.34	2.03	2.77
Nonprofit Control						
coefficient					14×10^{-2}	20×10^{-2}
t-value					2.65	3.39
MD Concentration						
coefficient	10×10^{-4}	15×10^{-4}		10×10^{-4}	20×10^{-4}	28×10^{-4}
t-value	2.52	2.62		1.74	2.61	2.72
Farm						
coefficient		-52×10^{-2}	-95×10^{-2}	-10×10^{-1}		
t-value		-1.75	-2.99	-2.64		
Elderly Population						
coefficient				-20×10^{-1}		
t-value				-1.80		
R^2	0.38	0.50	0.44	0.57	0.45	0.54
Determinant	0.88	0.58	0.55	0.38	0.56	0.56
Constant	63×10^{-2}	53×10^{-2}	80×10^{-2}	81×10^{-2}	53×10^{-2}	31×10^{-2}

The predictive power of the basic service mix percentage change analyses is modestly higher than those of the other Segment III percentage change analyses. The R^2s range from .34 in the Tristate comparison to .24 in the Michigan equation, as displayed in Table 21-9. Collinearity involving the Indiana Program is modest; the Program's covariance ratio ranges from .16 in the Michigan equation to .06 in the Tristate comparison. Overall collinearity is moderate, with the determinant never lower than .42.

The effects of the Indiana Program are clearly insignificant in all three equations. Farm population and bed size are the most consistent determinants of basic service mix. The former has a positive influence and the latter a negative effect. The percentage change in elderly

population has a negative influence in the Tristate and Combined equations. The Tristate comparison also contains two other determinants -- percentage change in ECF involvement and education level. The former has a negative impact and the latter a positive influence.

Table 21-9

PERCENTAGE CHANGE ANALYSES OF BASIC SERVICE MIX

	COMBINED	MICHIGAN	TRISTATE
Indiana Program			
coefficient	-11×10^{-3}	-76×10^{-3}	46×10^{-3}
t-value	-0.17	-0.94	0.63
% impact	-6.6	-36.3	40.0
covariance	0.08	0.16	0.06
% Δ ECF			
coefficient			-29×10^{-2}
t-value			-2.28
% Δ Elderly Population			
coefficient	-15×10^{-1}		-21×10^{-1}
t-value	-1.99		-2.15
Bed Size			
coefficient	-68×10^{-5}	-60×10^{-5}	-68×10^{-5}
t-value	-2.92	-1.75	-2.39
Farm			
coefficient	78×10^{-2}	14×10^{-1}	98×10^{-2}
t-value	1.72	2.09	1.71
Education			
coefficient			16×10^{-2}
t-value			2.20
R^2	0.26	0.24	0.34
Determinant	0.63	0.55	0.42
Constant	26×10^{-2}	23×10^{-2}	-17×10^{-1}

VII.

Segment IV: Influence on Hospital Management

The regression findings show that the Indiana system exerts a strong influence on hospitals. In light of these findings, it is essential to determine how the Indiana Program influences hospital management to produce its cost and other effects. That is, how is hospital behavior changed to achieve these results? Among key hospital decision makers -- administrator, financial officer, department heads, board, and physicians -- which are influenced by the Indiana system? And in what way?

This segment addresses these issues. It is thus directed toward the fourth study objective. Its most important component is Chapter 22 which uses site visit analysis to determine how the Program influences the operation of hospitals. Its other component is Chapter 23 which broadens the site visit findings by employing correlation analysis to examine the Program's effects on hospital staff characteristics. Unlike earlier chapters, these chapters discuss both the methodology used to accomplish their respective tasks and the results obtained.

22.
Impact on Hospital Operations

Earlier segments show that the Indiana Program has a strong negative effect on hospital cost and that the Program reduces cost by influencing productivity and resource use. The purpose of this chapter is to determine how the Program influences the operation of hospitals to achieve these effects. To accomplish this objective, this chapter analyzes the Program's impact on the behavior of key hospital decision makers.[1] It concentrates on the administrator since he/she is central to the Program's influence on hospitals. In addition, it examines the Program's effects on other important hospital decision makers -- the financial officer, department heads, the board, and physicians.

The main data source used in this chapter is two sets of site visits, both undertaken toward the end of this study by the project staff. The first consisted of visits to a randomly selected 20% subsample of Segment I Indiana hospitals, i.e., 17 institutions in that state. Based on comparison tests analogous to those discussed in Chapter 5, these hospitals closely resemble both the Indiana hospital universe and the Segment I Indiana hospitals.[2] At each hospital a comprehensive discussion was held with the administrator and usually with the financial officer as well. In addition, discussions were held with assistant administrators and department heads at some hospitals.

The second set of site visits was directed toward individuals playing important roles in the Indiana Program in the past and/or present. Included were interviews with Rate Review Staff members, IBC executives, IHA staff members, provider and public RRC members, and hospital managers generally influential in the state.

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[1] The term administrator indicates the immediate office of the hospital administrator or executive officer. In small hospitals, aside from clerical personnel this office may consist solely of the administrator. In larger hospitals it may also include several assistant administrators. The term financial officer is used analogously.

The term department head indicates individuals in charge of different hospital departments. Examples are the director of nursing, chief dietician, and head physical therapist. The term board refers to the hospital's governing body regardless of its formal title.

[2] As with the other comparison tests, the detailed results of these tests are shown in Appendix B.

These two sets of site visits have contrasting strengths and weaknesses which make them mutually supportive. The advantage of the first set is that its sample is not biased. That is, the sample does not consist exclusively of individuals who have worked closely with the Program or whose characteristics are significantly skewed along other dimensions. The disadvantage of the first set is that it does not secure the penetrating insights of those closely associated with the Program. The second set of site visits has opposite strong and weak points. Either set alone would thus not have been satisfactory, but together they constitute a strong information-gathering approach.

Unlike the earlier findings, this chapter's conclusions are not based on regression analysis. Instead, they are derived from qualitative analysis and integration of the site visit findings. Other information sources were utilized in this process, especially the Indiana Rate Review Manual (1977, 1971, 1962) and earlier Indiana site visits by the project staff. The findings are not drawn from any single year, but rather reflect the Program's continuing influence on hospital behavior.

Influence on Administrator

The site visit results show that the cornerstone of the Program's impact on hospitals is its strong influence on administrators. The Indiana Program is founded on the built-in desire of administrators to be efficient managers. Just as most physicians want to deliver high quality care, most hospital administrators want to be efficient managers, i.e., to use the appropriate inputs, to control costs, etc. That is, most administrators see themselves as professionals whose task is to manage well. This might not have been true 50 years ago, but particularly during the last quarter century hospital administration has developed steadily into an established profession. In fact, its youth may make its members strive even harder to establish their professional identity.

Primarily for two reasons, the Indiana Program is widely respected by hospitals. First, hospitals feel they have a strong voice in the development and operation of the Program. Most important, they do not think the Program was imposed on them by a remote agency. Second, the Program is seen as knowledgeable and tough but still fair. In the words of one hospital administrator, "The rate review system is objective. It neither rubber stamps a requested increase nor impulsively denies things." Hospital administrators think the Program (i.e., both the RRS and RRC) asks the right questions and demands on-point answers before rate increases are approved. According to another hospital administrator, if called before the Rate Review Committee, "You'd better know the answers to their questions."

Equally significant, the Indiana Program is directed toward the management of the hospital. It does not focus on whether a cost is allowable,

but instead stresses whether it is justifiable from the standpoint of efficient management. For example, the Program asks such questions as: Are nursing FTEs excessive? Are ancillary wages too high? Are dietary expenses out of line?

The Indiana Program with its management orientation and broad base of respect primarily influences hospital operations by inducing administrators to be more efficient managers. It encourages good hospital management partially through financial incentives (as will be discussed) but largely through professional incentives. It has established good hospital management as a goal and it enforces that goal through its review procedures. The Program succeeds because it reinforces the administrator's basic desire as a professional to be an efficient manager.

As one financial officer puts it: "Effective cost management is a way of life in Indiana." Another makes the same point in a different way: "You do well under the Indiana Program if you do your job well." Yet another argues forcefully that "hospitals need do nothing under the Indiana Program beyond those actions required by good management principles." An administrator of a small hospital concurs: "The Indiana Program is a system encouraging good management techniques rather than being just a cost-cutting program."

An integral part of the Program's professional incentives is the building of a reputation, which is important for several reasons. A solid reputation is respected by the Rate Review Committee. RRC and RRS members indicate that they gradually learn which hospitals' requests should be scrutinized in detail, and which should be accepted on a more straightforward basis. A small hospital administrator makes this point well:

> I value my reputation for credibility that I build each time I present my budget. Therefore, I do not request something that I don't have a good story for. I know the Rate Review Committee won't buy it.

A good reputation can also further professional advancement, at least in Indiana. The Indiana Hospital Association is usually consulted when an administrator vacancy occurs, and that association is highly involved in the Indiana Program. Although no published report compares administrators' performances under the Indiana Program, it is common knowledge among Indiana hospital people which administrators are efficient managers and which are not. Being considered among the former is regarded as a "feather in one's cap."

Two examples illustrate this point. In one instance an administrator who had announced his resignation received an inquiry from another administrator, who was not known as an efficient manager, about the upcoming vacancy. The resigning administrator did not recommend him

to the board as a candidate for the position. In the other instance an administrator gradually gained the reputation of being an inefficient manager. After several years, although his hospital was not in immediate financial jeopardy, his board replaced him, with at least one reason being his reputation for managerial inefficiency.

At an even more basic level a good reputation is valued for its own worth by hospital administrators, just as it is by other professionals. As a young administrator put it: "I would just not like to be around other administrators if I were frequently in trouble with the Rate Review Committee."

The largest fraction of the Program's cost savings is produced by its positive impact on hospital management. This improvement in management occurs because of three intertwined elements. The first is simply greater cost consciousness, i.e., greater concern and awareness about costs. In the words of one administrator:

> The biggest and most important impact the Indiana Program has had on our hospital is that the Program forces us to monitor cost -- to realize what goes into patient care costs.

Another puts it this way:

> I feel the major impact the Program has is its effect on the administrator in terms of heightened awareness of cost. If you asked me, without the Program would Indiana hospital administrators be cost conscious, I'd have to say yes. But if you asked me, would they be as cost conscious, I'd have to say no.

Another administrator also emphasizes this point. She indicates:

> The Program makes our hospital more cost conscious. Because of the Program we adhere very strictly to our budget. When I was at an Illinois hospital, we raised rates whenever we wished. Here, the Indiana Program forces us to watch costs and to pay particular attention to justifying costs.

The second element is improved planning, budgeting, and financial monitoring. The presence of the Program leads to better management because administrators must frequently review decision-oriented data which readily identifies certain problems and suggests corrective measures. This factor is particularly critical for small hospitals. According to one administrator:

> Small hospitals without rate review don't think through financial matters. I feel the Program forces you to budget, compare, revise within your rate. Certainly it has forced me to budget better.

This element is also an important consideration for larger Indiana hospitals, some of which have developed sophisticated financial reporting systems. Summarizing this factor, one administrator says: "The very act of regular and careful budget scrutiny teaches carefulness and control, and thus cost savings." Another concurs:

> The emphasis placed on me by the Indiana Program for cost containment is continuous -- it is not a once a year process. It's a continuing effort for me, my finance people, and my department heads to keep up-to-date on census, expenses, etc., and understand the costs.

The third element is the greater willingness of hospitals to make careful management decisions based on frequent evaluation of cost trade-offs. For example, one administrator says:

> We watch our staffing patterns very strictly. We feel that the Rate Review Committee puts the most emphasis on labor and staffing patterns and grills the hospital if they feel increases cannot be justified.

In another hospital the chief dietician has computerized an array of recipes. At frequent intervals he inputs the prices of different food items and obtains from the computer the most cost effective recipes. In a small hospital, an administrator persistently negotiated with insurance companies until he was able to substantially change the malpractice rating of his institution.

It is widely acknowledged in Indiana that working under the Program improves managerial ability. The Program is regarded as an educational mechanism which provides experience far more valuable than that obtained under retrospective reimbursement systems. Similarly, administrators point out that practical experience in Indiana improves managerial ability in ways beyond the reach of formal education programs. A young administrator emphasizes this facet of the Indiana Program when he says: "If I were to leave Indiana and take a position in another state, I would thank the Indiana Program for teaching me how to be a better administrator."

Another administrator makes the same point but in mirror image terms:

> When administrators come to Indiana from other states, they bitch initially about the Program's requirements. After a few years they become advocates of the Program, seeing that it improves their managerial ability.

As in other states, administrators of small Indiana hospitals have turned to management and accounting consultants. They feel strongly

that the Program's pressures have accelerated this process and most have been pleased with the assistance they have received. One small hospital administrator indicates:

> The Program has forced me to seek accounting talent and expertise from outside people. I learn more in four days with my outside accounting consultant than I do in a year on my own.

Another administrator in a small hospital beset by low occupancy stated:

> I turned to this hospital consulting firm after a bad year and I am utilizing them heavily. Their primary activity will be preparation of the prospective budget and the MCRs.

A smaller but still substantial fraction of the Program's cost savings is produced through the process of preparing rate requests. Most Indiana hospitals "point" for the rate review session; they organize their planning and budgeting activities in terms of the rate review cycle. In one large hospital these activities are carefully structured in sequential steps culminating in a two-day management retreat during which, among other matters, the upcoming year's budget is hammered out. In most hospitals the planning/budgeting process is not as formal, but it is nonetheless regarded as a central management activity. As one administrator puts it:

> It costs our hospital a considerable sum of money to produce the rate review document, since it is complicated. However, I feel that this process forces us to do a better job of rate setting. We end up with good dollar information which helps us implement better systems and techniques.

Under retrospective reimbursement a budget is a relatively empty document. A hospital need not regard it as binding. In contrast, under the Indiana Program the prospective budget is the basis for the prospective rates. Consequently, Indiana hospital administrators consider budget preparation a serious task through which economies can often be realized. They are fully aware that the Indiana Program will force them to carefully justify rate increases. As a result, they go over their budgets and proposed rates with a "fine-toothed comb," searching for possible cost savings. In the words of one administrator:

> I feel that preparing the rate case gives the hospital a valuable opportunity to look at dollars. Because of the Program we are always conscious of costs first and FTEs second.

Similarly, another administrator says:

> Because of the Indiana Program we devote more time and resources to budget preparation and planning. We have hired a private CPA firm to review our budget. We have a strong compunction to be thoroughly justified in every rate request. We will not go before the Rate Review Committee without a good, solid case. We feel without reservation that these efforts are worth it since they improve management and lower cost.

The smallest portion of the Program's cost savings is attained through specific RRC/RRS actions. Such actions certainly account for less than 20% of the Program's cost impact; they may constitute less than 10% or even 5% of its influence. However, these direct actions are important for two reasons. First, they may significantly constrain costs in some hospitals whose rate requests are persistently excessive. Second, and more important, the possibility that the Program will respond negatively to a rate request changes hospital behavior. It is the deterrent which underlies the Program's larger cost savings achieved through improved management and rate request preparation. According to one financial officer:

> A hospital never wants to take a chance on non-acceptance because of the delay and extra work of having to resubmit. Hospitals tend to be almost overly conscientious the first time, which I think is good. Further, the hospital knows in advance what they will and won't accept.

The experience of another hospital indicates that at times hospitals may test the system. Its administrator reports:

> We had one request turned down. After looking it over, we didn't even resubmit since we too felt it was just too high. Since then we have never been out of line with our requests and we have had no problems.

The actions of the Rate Review Staff may be as important in reducing costs as those of the Committee. The Staff reviews and clarifies the hospital's rate request, insisting that required data be accurately provided. In the words of one financial officer, "The formal process and that formal document must be completed their way." However, the RRS interprets its role flexibly, attempting to provide assistance to those hospitals needing it. One administrator reports:

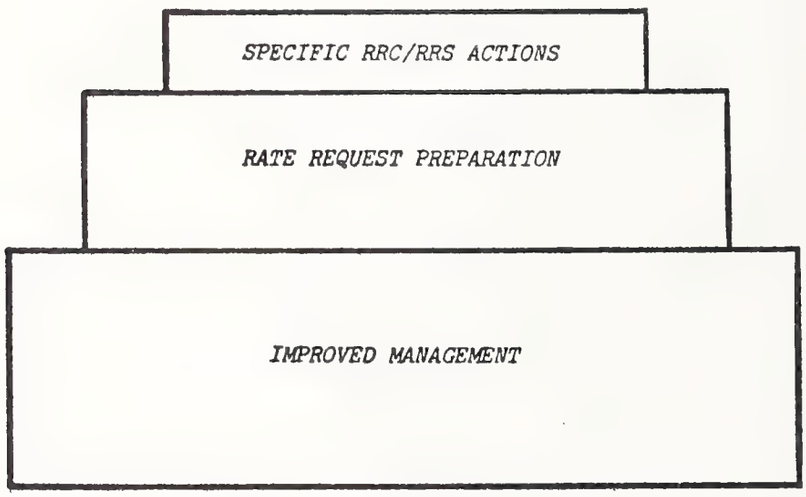
> In terms of our dealings with the rate review system the Blue Cross staff has had a greater impact. We think they are good and that they have fielded our questions and problems well.

The Rate Review Staff also serves another important function. They advise hospitals about which types of rate requests are likely to be approved by the Committee and which are not. As one administrator says, "The Blue Cross staff has worked to educate me on what will or will not get the support of the Rate Review Committee." This function makes the Indiana Program operate more smoothly since hospitals can revise out-of-line requests during the 45-day period between formal submission and review, thereby reducing both processing time and the Committee's workload. It also contributes to the cost savings produced by the Program, as do other RRS functions, such as summarizing rate cases for the Committee and monitoring hospitals granted conditional approvals.

The Program's cost savings are summarized in the three-tiered pyramid of Figure 22-1. The bottom and largest tier is cost savings produced by the Program's positive influence on hospital management. The second and intermediate tier is cost savings attained through preparation of the rate request. The top tier is cost savings resulting from specific RRC or RRS actions. This tier is the smallest of the three, but its presence is essential for the existence of the other two.

Figure 22-1

ORIGINS OF THE PROGRAM'S COST SAVINGS



The Program's financial incentives do not exert as strong an influence on administrators as do its professional incentives. However, both incentives are consistent and mutually supportive. Financial incentives thus contribute to the three-tiered cost savings produced by the Indiana Program.

On a retrospective basis the Program neither covers past losses nor extracts past gains. It does take into account a hospital's working capital in setting future rates. It is therefore impossible for a

hospital to reap a large profit on a continuing basis under the Indiana Program. Reflecting this fact, no evidence suggests that Indiana hospital administrators have the goal of "beating" the prospective rates by a wide margin.

It is equally clear that Indiana hospital administrators strongly prefer to meet their prospective budgets and show a small surplus or profit for the year. This is in part for professional reasons. Indiana administrators feel a strong compunction not to exceed the budgets they previously prepared and defended. They also dread the need for emergency rate requests since that reflects unfavorably on their reputation and since the rate setting system applies more stringent standards to such requests.

Economic factors reinforce these professional considerations. If a hospital exceeds its budget and does not seek and receive a rate increase, it will lose money and damage its present financial position, even if its losses can be largely recouped in future rate periods. Thus, both professional and financial incentives lead to the same conclusion -- meet the budget and encounter far fewer problems.

Two examples -- one real and the other hypothetical -- illustrate the importance of financial incentives in the Indiana Program. The first illustrates their negative side. An Indiana hospital administrator who was not a careful manager continually exceeded his budget and experienced short-term losses. As a result, the board became concerned. For this and other reasons it eventually fired the administrator, replacing him with an individual reputed to be a tough financial manager. Were Indiana a cost reimbursement state, this hospital's costs would simply have been paid; no budgetary infractions would have alarmed the board. The initial administrator would probably still be the administrator, and the hospital's management would be less efficient.

The second example demonstrates the positive side of the Program's financial incentives. In this case, an Indiana hospital administrator known as an efficient manager requests a modest rate increase. The RRS will review this request carefully, but if it encounters no major discrepancies its examination will be less painstaking than it would be for a hospital requesting a large increase or whose reputation is less favorable. The RRC considers difficult cases before easier cases. Its review of the latter may be almost perfunctory if the Staff recommends approval of the rate request and indicates that no significant problems were uncovered by its examination.

This prudent administrator has more latitude under the Indiana Program than do administrators who often request large rate increases, supply inappropriate numbers, and/or conceal important factors. As a result, he has the implicit freedom to include within his relatively low budget a few items not absolutely necessary, but of particular interest to him, his staff, the board, and/or the physician staff. The lesson is clear -- be efficient, control costs, and you will have more discretion.

As long as a hospital administrator operates within the Program's guidelines, there is a general willingness on the part of the Program to "let the administrator do his own thing." As one RRC member put it, "If the operation looks efficient and if cost increases are low, he must be doing something right, so why interfere?"

Impact on Financial Officer

The Program has two major effects on the financial officer, which are implied by the earlier discussions featuring quotations from these individuals. First, the Indiana system has drawn the administrator and financial officer together. The Program rewards careful planning and budgeting; it penalizes the reverse. If only the administrator is involved in planning/budgeting, either he/she will do a poor job because of insufficient attention to detail or he/she will in effect become the financial officer, thereby neglecting other functions. If only the financial officer is involved, planning/budgeting will be an empty exercise since the administrator will insufficiently understand and support the results.

The administrator and financial officer must therefore work together to achieve the level of planning and budgeting required under the Indiana Program. Illustrating this point is the fact that the financial officer often accompanies the administrator to Indianapolis when the hospital's rate case is considered by the RRC.

Second, the Program has increased the power and prestige of the financial officer. As pointed up earlier, under retrospective reimbursement a budget is a weak document since there is no compelling reason to adhere to it. Under the Indiana Program the budget is the hospital's management plan for the year, and strong pressures discourage major departures from this plan.

The financial officer is at the center of the budgeting/planning process. As noted above, he/she must work closely with the administrator in this area. Department heads also must work with the financial officer in discussing their plans during the preparation of next year's budget and their progress during the review of this year's budget. The greater emphasis on financial matters produced by the Program also makes the financial officer a more visible figure to the board and the physician staff.

The Program's enhancing influence on the financial officer is clear, but it should not be misinterpreted. The Program is management-oriented, not accounting-oriented. Its primary focus is the administrator. The financial officer becomes involved in two ways. First, he/she is responsible for the preparation of the numbers, and good numbers are essential for both good management and effective review by the Program. Second, the financial officer often assumes management responsibility in conjunction with the administrator.

In a global sense the Program's impact on the administrator and financial officer radiates from the increased emphasis that it forces the hospital to place on cost control. The function of the financial officer is to monitor and control cost. The administrator has a wider range of responsibilities, but foremost among them is prudent management, i.e., appropriate use of inputs and thus cost control. The Indiana system therefore strengthens both positions, just as a solid quality assurance program would enhance the position of the physician staff.

Influence on Department Heads

The site visit findings confirm the principle that department heads follow the administrator's lead. If the latter is concerned about costs, that concern will percolate down to the department heads. If the administrator feels no cost pressures, neither will the department heads. The Program consequently exerts a sizeable influence on department heads even though it has little direct contact with them.

This influence has two principal manifestations. First, the Program increases the involvement of department heads in planning and budgeting. According to one administrator:

> Participation in rate review has led to extreme cost consciousness throughout the hospital which has extended particularly to department heads, who are being held more and more accountable for their budgets and activities. The board requires regular reports submitted by department heads.

A financial officer in another hospital says:

> Department heads are far more involved now in budgeting and cost consciousness than they were previously. Although you can't attribute all this involvement to the rate review program, you can't exclude the system either.

Another financial officer puts the point more strongly:

> We have informed all department heads that we will be thoroughly reviewing their rate structures. Our goal is to make each department self-sufficient. We are forcing individual departments to hold to their budget guidelines. Knowing that the hospital has to go through the rate review process has made the department heads much more aware of the role they must play in cost containment.

An administrator of a small hospital argues even more forcefully:

> The budget agreed to by the board and approved by the Rate Review Committee must be followed quite precisely by the departments. Why? The reason is simple. I will accept responsibility for budgetary failures when I am before the board, but the department heads have no immunity from me. They will suffer financially if they go over the budget.

Second, the Program makes department heads more aware of costs and more concerned about finding ways to reduce costs. In the words of one administrator, "My philosophy has filtered down throughout the hospital so that even department heads begin to cut small items." A director of nursing states:

> I feel that department heads at our hospital are pretty cost conscious. Certainly they are aware of the rate review program and what the hospital must go through with the Rate Review Committee.

Another administrator says:

> Full recognition of my accountability to the Rate Review Committee has greatly increased my cost consciousness. We have a very open system of communication in the hospital. This has allowed my cost consciousness to permeate many hospital activities. Department heads have been very cooperative in this effort.

The increased involvement by department heads in planning, budgeting, and other management activities is an important step since cost control is more effective if it reaches the departmental level. This point has been recognized by many Indiana hospitals who have taken specific actions to involve department heads in financial matters and to educate them about such matters. According to the financial officer of a large hospital:

> We revamped our organizational structure so that management responsibilities would reach down to the sub-department level. We feel that this is an important step in increasing our managerial efficiency.

Hospitals have also undertaken educational efforts, as indicated by another financial officer's comment:

> Our department heads are more involved and aware of cost containment and budgeting than previously. We have encouraged this result administratively. We have also undertaken specific educational programs to further it. We give in-service seminars to department heads to familiarize them with the rate setting system and cost containment. In these seminars we emphasize that they cannot increase their budgets at will.

Nevertheless, Indiana hospitals frequently find it a slow process to get department heads motivated about costs. Two factors contribute to this. First, in any organization there is a tendency for department heads to "build their own empires." This inclination is strengthened in the hospital because department heads instituting cost savings often receive immediate negative feedback from patients and particularly physicians. For example, if the head of the operating suite cuts the range of equipment available, she/he may be struck immediately by strong physician protests.

Second, most department heads are trained to deliver services, not to restrain costs. Many consider themselves professionals whose main job is to provide patient care rather than to manage resources. In many instances this creates a healthy tension in the hospital environment. It would not be desirable for hospitals to be staffed entirely by individuals whose paramount concern is cost control. Nonetheless, it makes it difficult to teach and induce department heads to be efficient managers as well as effective providers of care. In the words of one hospital administrator:

> I feel my department heads are not as involved as they should be. This is typical of small hospitals since here department heads tend to be the best technicians, not necessarily the best managers.

Another administrator makes the same point in a different way.

> It is a constant struggle to cut costs and maintain quality, especially in the nursing area. Nurses get very upset if they think you are cutting so much that you are affecting quality. Still, I now feel that we are getting department heads to the point where they are questioning all new and unnecessary costs.

Because of these factors, administrators, especially in small hospitals, may be reluctant at times to give department heads planning, budgeting, and other responsibilities. According to one financial officer:

> Even at our large hospital many department heads still aren't interested in getting involved in cost issues. At many small hospitals the administrator may simply tell the department head what his budget will be. The administrator is afraid that if the department head prepares the initial budget, he will pad it.

A small hospital administrator basically supports this position, but emphasizes department heads' managerial inexperience rather than a tendency to inflate budgets. He says:

> Our hospital is a very tight financial operation. Perhaps if we were making more money I might be willing to give more responsibility to department heads. It's simply a long, slow process educating them.

Despite these factors, department heads sometimes become more zealous in cutting costs than either administrators or financial officers. According to one small hospital administrator:

> Recently we had a severe blizzard which disrupted transportation and made it necessary for us to use overtime labor. Our EKG department head became very concerned about this development since it would upset her monthly payroll projection.

Effects on the Board

The site visit findings show that the Indiana Program has had little direct contact with hospital boards. RRC/RRS members report that it is uncommon for a board member to accompany an administrator when the hospital's rate request is considered by the Committee. Some RRC members have argued that it should be mandatory for at least one board member to be present if not for annual rate requests, at least for emergency requests.

Although the board may be unfamiliar with the details of the Program's procedures, it is well aware of the Program's presence. A hospital administrator says:

> The board's finance committee thoroughly reviews all rate structures before the rate proposal is submitted. The board is quite cognizant of costs and of the existence of the Rate Review Committee. A board member (CPA) attended the last RRC meeting.

Several hospitals indicate that they are actively educating their boards about financial matters and the rate review program. In the words of one hospital administrator:

> Since the rate review process has always been a mystery to the board and to the finance committee, we instituted a series of in-service seminars. At present these are offered for department heads, administrative staff, and the financial committee of the board. These seminars last three hours each and their subject is cost containment.

The Indiana Program has pre-empted some of the board's prerogatives. In a retrospective reimbursement environment the hospital's budget is approved only by its board. Even in a Type II environment only large capital expenditures are subject to outside review by planning agencies. In distinct contrast, an Indiana hospital's budget may be approved by the board, but may be rejected by the Rate Review Committee. The board can veto any budget item, but it cannot grant final approval since there is a review stage beyond the board.

Although Indiana hospital boards could thus be resentful of the Indiana Program, feeling that it usurps some of their responsibilities, there is no evidence of such a development. Instead, board members in general are favorably inclined toward the Program and believe that it plays an important role in the complex process of monitoring and controlling hospital costs. In fact, some board members explicitly welcome the Program's presence as a mechanism for improving hospital decision making. One board member, an economist, makes this point in the following way:

> The Program forces an affordability sort of thinking, from my perspective, much like that present at the board level of a for-profit institution. . . . Board members, from my experience, appreciate, welcome, and use this external force as a means of testing the judgment of administration, staff, and board much as do board members of a for-profit business use the force of market pressure.

Even though some board members thus explicitly rely upon the Indiana Program, it is nonetheless clear that on the whole the Program does not influence hospitals primarily by impacting the board. That is, the chain of influence does not go from the Program to the board to the administrator. Further, the Program and the board do not overtly work together to lower costs. Nor is it common for the Program to explicitly use the board as a lever on the administrator.

The presence of the hospital board nevertheless reinforces the professional and financial incentives of the Program. If an administrator's rate request is met by other than full approval, he/she must explain

the reason not only to his/her staff but also to the board, which is usually composed primarily of community representatives. The presence of the board thus constitutes one further incentive to function successfully under the Indiana Program. It is not the most important incentive, but it contributes to the Program's effectiveness.

As is probably true in other states, the innate cost consciousness of the board varies substantially among Indiana hospitals. On the one hand, an administrator describes his board as being:

> . . . conservative all the way, and perhaps too conservative. Cost consciousness prevails on the board but would even without the Indiana Program.

Another administrator seconds this opinion:

> My county board is no paper tiger. It exerts consistent pressure to toe the budget line. The citizens of this small rural community want to know what's going on, believing that their tax dollars still support this hospital, which in fact they don't.

On the other hand, several administrators argue persuasively that "a good administrator can get almost anything by the board." One of these individuals contends:

> The board does not get concerned in the financial area unless the hospital is losing money. Occasionally the board may get upset simply because rates are too high or increasing too fast, but that's rare unless there's a lot of publicity. In most cases the board is just not a sufficient check assuring cost control.

There is also wide divergence in the sophistication of boards. One large hospital created a series of committees whose task is to examine different aspects of hospital planning and operations. Board members as well as physicians and administrative staff serve on these committees. In contrast, a small hospital administrator reports:

> I have been working to educate the board about rate setting. When I came they didn't even know that you had to submit a budget for rate review. In fact, they were not even seeing the yearly financial statements.

There is a general feeling that rural boards are more conservative than urban boards. As one administrator put it:

> Rural hospital boards in Indiana are more conservative generally than urban boards. Rural boards are particularly concerned about the pecking order of hospitals in their area and about being competitive with the costs of surrounding hospitals.

Opinions were also voiced that county hospital boards are more stringent than private nonprofit hospital boards. At the same time it was felt that the former are more political and less consistent than are the latter. One county hospital administrator stated:

> I consider my county board stifling. Things are looser under the rate review system, particularly in the area of sensitivity to excess revenues. The county would be extremely tight here; the very incentives of the Indiana Program have changed attitudes toward revenue.

Another county hospital administrator reports:

> The board makes its pressure felt through various and unavoidable political means. Yet they don't take responsibility when any flak is flying.

Another county hospital administrator indicates that his board functions well:

> The county commissioners have always picked good people for my four-member board. The people chosen have gotten interested in the hospital and have provided real assistance.

These rural and county board contentions receive no support from the Segment I results. Neither farm population (or urban population) nor nonprofit control exert a significant influence on cost in the Segment I analyses. This result does not necessarily mean that rural and/or county boards are not more stringent than others. It does mean that if they are more conservative, this characteristic is not sufficient to override other characteristics associated with rural and/or county hospitals.

Impact on Physicians

Affirming a major study premise, the site visit findings indicate that the Indiana system has only a modest impact on physicians and that it does not reduce hospital costs by influencing physicians. When asked what was the Program's effect on physicians, a physician member of the

Rate Review Committee replied, "hardly any." A nonphysician RRC member replied to the same question, "almost none." The same point is made by a small hospital administrator who says:

> The Program does not impact physicians. To do so would be a giant task. I have tried confronting them head-on on certain issues and I have lost.

In particular, there is universal agreement that the Program has not influenced the way physicians practice medicine. That is, it has not affected their admitting practices, diagnostic workups, or treatment patterns. A hypothetical situation was posed to a number of individuals interviewed during the site visits. In this situation an administrator convenes the physician staff and strongly suggests that they change their methods of diagnosis/treatment. The administrator might instruct the physicians to order more laboratory tests for the treatment of diabetes or to reduce the level of nursing services for the treatment of duodenal ulcers. Without exception, those to whom this hypothetical situation was described felt that its actual occurrence was exceedingly remote.[3] As one administrator put it:

> You might be able to get away with it once if you're lucky. If you did it twice you'd be out on your ear.

Despite its general lack of influence on physicians, the Program may still affect them in several specific ways. First, some physicians have become involved in the administrator's cost control efforts. One small hospital administrator reports:

> Physicians here have become imbued with cost control awareness. They are more conscious of the channels their requests must pass through. They are more selective about equipment, supplies, etc., weighing cost and quality carefully.

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[3] In contrast, the New York program may have created an incentive system which influences the way physicians practice medicine. Dowling et al. (1976a) indicate that such instances appear to be unusual, but they cite in detail one specific case:

> . . . Most administrators understood that an increase in patient days is clearly to a hospital's advantage. One controller went so far as to explain a mechanism he has used to keep volume up. On days when occupancy slips, he merely goes to the residents' lounge and posts an announcement saying that the occupancy is low. The residents get the idea and are a little slower discharging patients.

A financial officer in another hospital has more mixed feelings, but is still basically positive when he reports:

> Things are looking up. We have been somewhat successful in getting our chief of staff more involved in cost control. He is influential among the physicians here. Still, at present the physician staff doesn't want to do anything more than is necessary in the area of cost control.

Reflecting in part the natural tension between the administrator as the controller of costs and the physician as the provider of services, a more common theme among administrators and financial officers is the frustration of cost control efforts by physicians. One small hospital administrator indicates:

> Recently I had to purchase $16,000 in new lights and tables for some physicians -- items that were necessary only because of their preferences. Physicians also interfere with savings efforts in the purchase of supplies since they insist on one brand over another.

Another administrator states:

> Unjustified physician preferences have foiled our thrift moves time and again. When physicians complained about a switch in I.V. brands, I gave them a time period to evaluate the new brands. No input was forthcoming, but the physicians still feel a blow to their pride if they're not consulted.

A second way in which the Program may influence physicians is in the capital expenditures area. In some hospitals physicians have become highly involved in capital planning. One example is the large hospital noted previously, which employs committees composed of physicians, administrative staff, and board members to examine future capital needs and other issues. Another example is a small hospital whose administrator says:

> This is the third year in which the physician staff has met directly with the hospital board to discuss their capital and other needs. This step was initiated by me. I consider it one of my best moves.

In most hospitals such physician involvement remains uncommon. In the majority of hospitals the administrator and board usually consent if strong physician staff members wish to add a particular service. Similarly, planning agency acquiescence is generally forthcoming since strong physician support makes a distinct impression on such agencies.

In some instances administrators are successful in deflating physician capital requests by pointing to the Indiana Program as a bogeyman. The same approach has also been invoked in dealing with department heads and board members. According to one financial officer:

> The Indiana system keeps costs in line because it makes us mindful of costs. Also, we can always say to physicians or the board -- 'Will it get through rate review?'

Another administrator states: "I use the Rate Review Committee as a reason for not doing certain things for both the board and department heads." A financial officer reports:

> Department heads will often contact me in an attempt to increase one or another rate during the year. My response is always -- 'You can't do that. You must have approval from the Rate Review Committee for that to take effect. We'll look at it when we prepare the next submission, but not now.'

A small hospital administrator also reflects this point when he says:

> I cannot be convinced to get a piece of sophisticated equipment requested by a physician if I feel the community doesn't need it. The reason is that I cannot honestly justify it to the Rate Review Committee unless I am so convinced.

A third way in which the Program can affect physicians is in the negotiation of contractual and other arrangements for the delivery of pathology, radiology, emergency room, and similar services. The general feeling is that the Program has had a restraining influence in this area, but that its effect here is more modest than its impact in other areas. Illustrating the Program's influence is this report by a hospital administrator:

> Several years ago our pathologist told us that his rates would have to increase substantially because they were no longer in line with pathologist rates in surrounding areas. After considering the matter, I told the pathologist that I could not support the rate increase because I could not justify it to the Rate Review Committee. However, I indicated that if the pathologist wanted to defend the increase to the Rate Review Committee, then I would accept it to the extent that the Committee accepted it. As you might guess, the pathologist decided not to appear before the Committee, and to instead forego his rate increase.

Another hospital administrator substantiated the Program's influence in this area by indicating:

> We are presently renegotiating our pathologist contract. We know that we must operate within certain limits imposed by the Program. Hence, if pathologist candidates propose certain arrangements, we know that we have no choice but to tell them that we cannot accept such arrangements because the Rate Review Committee will not buy them.

More common is the experience of another hospital administrator who says:

> Hospitals have not been tough enough in the physician contract area. I'm sure this is one area in which the Program's impact is not as strong as it is in others. Shortly I intend to renegotiate some of my physician contracts. It's going to be tough, but I am going to push hard to get a better deal for the hospital.

23.
Effects on Hospital Staff Characteristics

This chapter extends the previous chapter's analysis of the Indiana system's influence on hospital management by examining the Program's impact on hospital staff characteristics. Because of the earlier study findings this chapter focuses on the administrator and financial officer, but it also considers the board and the physician staff.

Specifically, the chapter analyzes the Indiana Program's influence on five hospital staff characteristics: administrator attributes, financial officer characteristics, board characteristics, physician attributes, and key personnel turnover. These subjects are addressed sequentially in the initial five chapter sections, each of which has three subsections. The first subsection discusses the Program's expected impact; the second describes the variables used in the analyses; and the third presents the analysis findings showing the Program's effects. The final chapter section interprets the analysis findings as a whole.

This chapter uses correlation, rather than regression analysis. Accordingly, for the reasons discussed in Chapter 6, its results are less definitively established than the findings of Segments I-III. Like most of Segment III, this chapter's analyses compare Indiana hospitals with the Combined control hospitals since, as demonstrated in earlier segments, the Michigan planning program has little influence on hospitals.

Except for the personnel turnover analyses, which include all years between 1968 and 1973, the time period used in this chapter is 1973. The data source is the Project Survey, which is also used extensively in Segment II. This chapter's sample is therefore highly similar to that of the earlier segment. It contains 145 Segment I hospitals, 134 of which are also in Segment II. Among the 145 institutions are 54 Indiana hospitals, 43 Michigan hospitals, and 48 Tristate hospitals. The Chapter 23 sample thus encompasses 63% of Segment I Indiana hospitals and 59% of all Segment I hospitals.

Comparison tests analogous to those described in Chapter 5 were used to assess the representativeness of this sample. The detailed findings of these tests are shown in Appendix B. Test A indicates only one significant difference between the Chapter 23 and non-Chapter 23 hospitals. In Test B there are two significant differences and in Test C there are no significant differences.

The Chapter 23 and non-Chapter 23 hospitals thus closely resemble each other. Like the Segment II hospitals, the Chapter 23 sample is self-selected. However, any self-selection bias is unlikely to be sufficiently

large to override the strong similarity between the Chapter 23 sample and both the Segment I sample and the Indiana hospital universe. This chapter's findings can therefore be generalized to the Indiana hospital universe.

Administrator Characteristics

Expected Impact of Indiana Program

Three attributes of the administrator are analyzed. One is the level of his/her education. Another is the administrator's tenure in his/her present position, i.e., the length of time spent in that position. The third is the administrator's general experience as a hospital manager, i.e., the number of years spent in high administrative positions.

Because the Indiana Program places a premium on managerial efficiency and accurate budgeting/planning, the greater the administrator's expertise in these areas the better he/she will fare under the Indiana Program. In this occupation as in others, several roads lead to expertise. One is education. An administrator with advanced training is generally more expert than one without such training. General experience in hospital administration is another since the greater such experience, the more likely the administrator can knowledgeably handle an array of problems. A third is specific experience in the present position. Although hospital administrators like other managers can become stale, this type of experience enables the administrator to become thoroughly familiar with the subtleties of his/her institution.

It thus would seem likely that the Indiana Program has a positive influence on all three administrator characteristics. However, tradeoffs among these variables arise because hospital administration is a young profession in a field characterized by rapid technological advance. As a result, the more experienced the administrator, the less likely that he/she has an advanced degree, and vice versa. Although there are individual exceptions, this professional field is generally divided into two clusters -- more experienced administrators with less advanced education, and less experienced administrators with more advanced education.

These clusters encompass widely varying expertise. For example, in the first cluster an administrator's savvy may make him/her extremely effective, while another's limited technical understanding may sharply constrain his/her capabilities. In the second cluster one administrator may successfully invoke sophisticated techniques ranging from computerized budgeting to industrial engineering, while another frequently blunders because of inexperience.

Thus, for the administrator, neither education, experience, nor tenure are unambiguous indicators of managerial expertise, the quality rewarded by the Program. It is therefore likely that the Program's impact on these characteristics is insignificant.

Variable Construction

Administrator tenure is defined as the number of years the administrator has occupied his/her present position. The experience of the administrator equals the total number of years spent as an administrator of any hospital or as an associate/assistant administrator in a hospital with at least twice as many beds as the present hospital. Administrator education is a scaled index which ranges from 1 to 5. It has four mutually exclusive components whose values are shown in Table 23-1.

Table 23-1

COMPONENTS OF ADMINISTRATOR EDUCATION INDEX

Index Component	Value
Advanced Degree in Hospital/Health Administration (including MBA with emphasis in these areas)	5
Other Advanced Degree	3
Baccalaureate Degree	2
No Degree	1

The mean for the experience variable is 12.68 years. Average administrator tenure is lower but still substantial at 8.30 years. The mean for administrator education is 3.54, indicating that the average study hospital has an administrator with an advanced degree. The variation in all three measures is sizeable. The coefficient of variation equals .46 for the education index and .65 for the experience variable. As expected, it is highest for the tenure measure, equalling .87.

Effects

The findings fully substantiate the hypotheses concerning administrator characteristics. As shown in Table 23-2, the correlations between the Indiana Program and the three administrator variables are highly insignificant, approaching zero. The highest such correlation is that involving administrator education, .05. The Program's other correlations are .01 and -.04 with the experience and tenure variables respectively.

Table 23-2

EFFECTS ON ADMINISTRATOR CHARACTERISTICS

Administrator Characteristics	Correlation with Indiana Program
Education	.05
Experience	.01
Tenure	-.04

Financial Officer Characteristics

Expected Impact of Indiana Program

This section examines three financial officer characteristics: education, experience, and tenure, which are defined analogously to the administrator variables described earlier.

Since the financial officer is central to the hospital's financial management, hospitals with able financial officers will function more successfully under the Indiana Program than will those with less able financial officers. The Indiana Program thus encourages financial officer expertise as it does administrator expertise.

Although each financial officer characteristic contributes to financial officer expertise, no single characteristic unambiguously portrays such expertise. Consequently, as with the administrator variables, the Program's effects on the financial officer variables are likely to be insignificant.

Variable Construction

Financial officer education is a scaled index ranging from 1 to 6 whose mutually exclusive components are displayed in Table 23-3. The tenure of the financial officer is defined as the number of years he/she has occupied his/her present position. The experience of the financial officer equals the total number of years spent as a financial officer in any hospital.

Average financial officer experience is 7.59 years, which is only slightly higher than average tenure, 6.57 years. Average financial officer education is 2.88. Similar to the administrator variables, substantial variation exists in these financial officer characteristics. The coefficient of variation is highest for the tenure variable, .87; almost the same for the experience variable, .84; and lowest for the education measure, .56.

Table 23-3

COMPONENTS OF FINANCIAL OFFICER EDUCATION INDEX

Index Component	Value
Certified Public Accountant (CPA) and Advanced Degree in Hospital/Health Administration, Finance, Accounting, or Related Field	6
Certified Public Accountant	5
Advanced Degree in Finance, Accounting, or Related Field	5
Advanced Degree in Hospital/Health Administration	4
Baccalaureate Degree with Major in Accounting	3
Other Advanced or Baccalaureate Degree	2
No Degree	1

Effects

The findings fully support the financial officer hypotheses. The correlation between the Indiana Program and each financial officer variable is highly insignificant, as indicated in Table 23-4. As with the administrator characteristics, these correlations all approach zero. The highest, -.04, involves financial officer tenure. The other two correlations are -.03 and .01 with the experience and education variables respectively.

Table 23-4

EFFECTS ON FINANCIAL OFFICER CHARACTERISTICS

Financial Officer Characteristics	Correlation with Indiana Program
Education	.01
Experience	-.03
Tenure	-.04

Board Characteristics

Expected Impact of Indiana Program

Four hospital board attributes are examined. The first is board size. The second is administrator membership on the board. The third is board breadth, defined as the number of different occupations represented on the board. The fourth is concentration of board expertise which indicates the extent to which board members are drawn from the same occupations.

As discussed in the previous chapter, the Indiana Program has not impacted hospitals primarily by influencing the board of trustees. It is thus unlikely that the Program has directly affected board composition. The Program possibly influences board characteristics through its financial pressures on hospitals. That is, the hospital may attempt to improve its managerial and financial expertise by securing appropriate individuals for its board. However, it seems more likely that in such instances the hospital will strengthen its financial officer function, add assistant administrators in specific areas, or even replace the administrator.

A major consideration is that in many hospitals board composition is dominated by factors other than the Indiana Program. For example, many county hospitals in Indiana must have four-member boards by state law. As another illustration, some church-affiliated hospitals have boards composed primarily or exclusively of clerical and/or lay members of the church.

For all these reasons it is unlikely that the Indiana Program has a significant influence on board characteristics. However, its correlation with board size is expected to be negative because of the Indiana laws noted above which regulate county hospitals. Similarly, its correlation with board breadth is likely to be negative because of the strong positive relationship between this board characteristic and board size. In contrast, concentration of board expertise, which also reflects board diversity but is relatively independent of board size, is expected to be insignificantly associated with the Indiana Program.

Variable Construction

The board size variable equals the number of members on the hospital board divided by the number of hospital beds. Bed size is used as a deflator in this variable since larger, more complex hospitals may require more board members. Administrator board membership is a dichotomous variable in which (1) denotes the presence of the hospital's administrator on the board and (0) indicates his/her absence.

Board breadth equals the number of occupations encompassed within board membership. Among the occupations included in this measure are hospital administrator, physician, other health facility administrator, lawyer, government official, educator, housewife, industry manager, banker, farmer, and clergy.

Concentration of board expertise equals 100% minus the ratio of the number of board occupations to the number of board members. Hence, as the heterogeneity of the board rises, this variable decreases.

The mean of board size is .09, indicating that on average a study hospital has one board member for every ten beds. The mean for administrator board membership is .26, which means that approximately one quarter of study hospital administrators are members of their boards. Average board breadth is 5.97, denoting that approximately six occupations are represented on the average hospital board. Mean concentration of board expertise is .42, indicating that the average board has almost twice as many members as occupations. The variation in the continuous board variables is large. The coefficient of variation equals .84 for board size, .44 for board breadth, and .55 for concentration of board expertise.

Effects

The findings corroborate the hypotheses concerning board characteristics. As displayed in Table 23-5, the correlation between the Indiana Program and concentration of board expertise is insignificant, equalling -.06. The Program's correlation with administrator board membership is higher, but still insignificant, -.11. The correlations with board size and board breadth are significantly negative, but relatively modest. Further, they are almost the same: -.22 for board size and -.21 for board breadth. Together with the Program's insignificant correlation with concentration of board expertise, this finding indicates that the Program's correlation with board breadth is primarily due to its association with board size.

Table 23-5

EFFECTS ON BOARD CHARACTERISTICS

Board Characteristics	Correlation with Indiana Program
Size	-.22
Administrator Membership	-.11
Breadth	-.21
Concentration of Expertise	-.06

Physician Characteristics

Expected Impact of Indiana Program

In this section six physician staff characteristics are analyzed. One is staff size. Another is the openness of the staff, defined as the percentage of staff physicians who also actively practice in other hospitals. The other four variables indicate the relative prevalence of different specialties on the physician staff. These variables are general practitioner dominance, primary care physician dominance, surgeon dominance, and nonclinician dominance.

The Indiana Program has only a modest influence on physicians. This point is demonstrated both by the site visit findings reported in Chapter 22 and by the regression results of the earlier segments, especially Segment III. It is therefore unlikely that the Program affects physician staff characteristics.

The correlation between the Indiana Program and general practitioner concentration is .31 in Segment II -- the segment whose sample is most similar to that employed in these analyses. Accordingly, the Indiana Program will probably have a positive correlation with general practitioner dominance in this analysis. However, the factor responsible for this expected correlation is not the Program, but rather general practitioner concentration.[1]

Variable Construction

Physician staff size equals the number of physicians on the hospital staff divided by the number of hospital beds. The rationale for using bed size as the denominator in this variable is the same as that for the board size measure. The numerator of physician staff size is defined as the number of physicians with full admitting privileges, i.e., usually those on the active or associate staff. Openness of the physician staff is defined as the estimated percentage of staff physicians who are on the active or associate staff of at least one other hospital.

The physician dominance measures are defined as the number of staff physicians in the specified specialties divided by the total number of staff physicians. The particular specialties included in each of these measures are shown in Table 23-6.

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[1] This expected finding illustrates the strength of multivariate analysis. If regression, rather than correlation, analysis were used in this segment, the Program's impact on general practitioner dominance would probably be insignificant since the effect of general practitioner concentration would be taken into account.

Table 23-6

COMPONENTS OF PHYSICIAN DOMINANCE MEASURES

Physician Dominance Measures	Specialties Included in Numerator
General Practitioner	General Practice
Primary Care Physician	General Practice, Internal Medicine, Pediatrics, Obstetrics/Gynecology
Surgeon	General Surgery, Surgical Specialties (excluding Obstetrics/Gynecology)
Nonclinician	Radiology, Pathology, Anesthesiology

Mean physician staff size equals .34, indicating that on average a study hospital has one active physician for every three beds. Average openness of the staff is .45, denoting that more than one half of the physicians in the average study hospital practice only in that hospital. As expected, the variation in this measure is large, with its coefficient of variation equalling .82. Variation is also substantial in physician staff size; its coefficient of variation is .68.

Average general practitioner dominance is .42, while this statistic for primary care physician dominance is .60. Thus, on average more than one half of the physicians at a study hospital are primary care physicians. About two thirds of those physicians are general practitioners. The mean for surgeon dominance is .24, denoting that in the average study hospital about one quarter of staff physicians are surgeons. Average nonclinician dominance is lower, .13, indicating that almost 15% of the physicians in an average hospital are pathologists, radiologists, or anesthesiologists. As expected, among these four variables variation is lowest in the primary care physician measure. Its coefficient of variation is .27. This statistic is similar among the other three measures, equalling .60 for general practitioner dominance, .54 for surgeon dominance, and .62 for nonclinician dominance.

Effects

The physician hypotheses are almost entirely supported by the results. As indicated in Table 23-7, the Program's correlation with physician staff size is negative but insignificant, -.13. Its correlation with openness of physician staff is almost zero, -.01.

Table 23-7

EFFECTS ON PHYSICIAN STAFF CHARACTERISTICS

Physician Staff Characteristics	Correlation with Indiana Program
Size	-.13
Openness	-.01
General Practitioner Dominance	.16
Primary Care Physician Dominance	.08
Surgeon Dominance	-.10
Nonclinician Dominance	.17

Insignificant correlations exist between the Program and both primary care physician and surgeon dominance, .08 and -.10 respectively. The correlation with general practitioner dominance is positive, but modest, .16. This correlation is much lower than the .31 correlation between the Program and general practitioner concentration in Segment II. A factor which probably contributes substantially to this result is that general practitioners are usually staff members in fewer hospitals than are other types of physicians.

The only unexpected finding is the positive correlation between the Program and nonclinician dominance. However, this correlation is modest, .17, so that the degree of common variation between these variables is only 3%.

Turnover of Key Personnel

Expected Impact of Indiana Program

This section is directed toward changes in important hospital positions. Accordingly, four variables are examined: administrator turnover, financial officer turnover, nursing director turnover, and chief pathologist/radiologist turnover.

As with administrator and financial officer tenure, the Program is likely to have conflicting effects on turnover in these two positions. Its financial pressures will encourage the retention of individuals performing well in these positions. Conversely, such pressures may contribute to the departure of those not performing well. As a result, the Program is not expected to have a significant impact on these variables. Similar logic prevails for changes in the nursing director and chief pathologist/radiologist positions.

Supporting these expectations is the Indiana Program's gradual evolution. If the Program in its present form were suddenly instituted, the result might well be increased turnover of all these positions during the ensuing several years.

Variable Construction

Three of these variables -- administrator turnover, financial officer turnover, and nursing director turnover -- have precisely analogous definitions. Each measure ranges from 0 to 6, with the value equalling the number of years between 1968 and 1973 that a change occurred in the respective position. Thus, if no change occurred, the variable equals 0; if a change took place in each of the six years, the variable equals 6.

The pathologist/radiologist variable is defined similarly. It includes changes in both the chief pathologist and chief radiologist positions. This measure ranges from 0 to 12. That is, if there were no changes in either position, this variable equals 0; if there was turnover in each position in every year, the variable equals 12.

Average turnover in the administrator and financial officer positions was similar -- .67 for the former and .74 for the latter. Thus, on average study hospitals experienced less than one change in each of these positions during the study period. Average nursing director turnover was higher, but not substantially, equalling .90. Taking into account that pathologist/radiologist turnover includes two positions, its mean is distinctly lower than those of the other measures, equalling .49.

As expected, variation in these measures is substantial. It is highest for pathologist/radiologist turnover. The coefficient of variation for this measure equals 1.94. This statistic is the same for administrator and financial officer turnover, 1.18, and is lowest for nursing director turnover, .87.

Effects

The hypotheses in this area are fully substantiated by the findings. As shown in Table 23-8, the Program's correlations with the turnover variables are all insignificant. It has the highest correlation with pathologist/radiologist turnover, .13. Its next strongest correlation is with nursing director turnover, -.06, while its correlations with the other two variables are very low, equalling .01 for administrator turnover and .00 for financial officer turnover.

Table 23-8

EFFECTS ON KEY PERSONNEL TURNOVER

Key Personnel Turnover	Correlation with Indiana Program
Administrator	.01
Financial Officer	.00
Nursing Director	-.06
Pathologist/Radiologist	.13

Overall Interpretation

The administrator and financial officer findings have important implications. They indicate that the Program's effect on cost was attained without increasing the formal education of Indiana administrators and financial officers beyond that in the control hospitals. Similarly, it was not necessary to have more experienced administrators and financial officers in Indiana hospitals than in control hospitals in order to achieve the Program's cost effect. Nor does this effect depend upon Indiana administrators and financial officers having greater tenure in their present positions than do their counterparts in the control hospitals.

These findings demonstrate that significant changes in the basic credentials of administrators and financial officers are not a necessary condition for the Indiana Program's cost impact. It is likely that this conclusion also holds for other prospective rate setting programs. This is important since the education, experience, and tenure of administrators and financial officers can change substantially only over a sizeable time period. Changes of this type would significantly delay the realization of prospective rate setting effects if they were a necessary condition for those effects.

Instead, based on the Indiana experience, the reverse holds. A prospective rate setting program can exert a strong influence on cost by working with the individuals who currently manage hospitals. The personnel turnover findings also support this point. Between 1968 and 1973 changes in the administrator and financial officer positions occurred no more frequently in Indiana hospitals than in control hospitals. The same finding holds for changes in the nursing director and chief pathologist/radiologist positions.

The size of the hospital board is smaller in Indiana than in the control areas. Correspondingly, the breadth of the board is smaller in Indiana hospitals. These associations, while significant, are modest in

magnitude. More important, the causative factor is not the Indiana Program, but rather Indiana state laws limiting the board size of county hospitals. The concentration of board expertise -- a factor reflecting board diversity, but not appreciably influenced by board size -- is the same in Indiana and control hospitals, as is administrator membership on the board. These findings are consistent with the thesis that the board plays a secondary role in achieving the Program's influence on hospitals.

Physician staff characteristics are similar in Indiana and control hospitals -- a finding consonant with other study results. This finding holds for staff size, openness of the staff, primary care physician dominance, and surgeon dominance. There is a positive association between the Program and general practitioner dominance, but this association is only narrowly significant, and is much lower than the correlation between the Program and general practitioner concentration in earlier segments. There is also a positive association between the Program and nonclinician dominance. However, this association too is only barely significant, and given the Segment III and Chapter 22 findings, does not have appreciable implications.

As emphasized earlier, these findings are based on correlation analysis and should thus be interpreted more cautiously than the regression results of the previous segments. However, in many instances the correlations are so low that it is unlikely that regression analysis would reveal a significant influence by the Program on these characteristics. This is particularly true for the correlation findings indicating the Program's insignificant impact on the characteristics and turnover of administrators and financial officers. The Program's highest correlation with any of these variables is .05.

VIII.

Segment V: Operating Expenses

As with any endeavor, resources must be expended to operate the Indiana Program. The costs of these resources offset to some degree the Program's hospital cost savings. It is therefore necessary to determine their magnitude.

This segment assumes this task. Its focus is thus the fifth study objective. It contains only a single chapter -- Chapter 24 -- which, analogous to the Segment IV chapters, discusses both the methodology and findings of Segment V.

24.
Operational Costs of the Indiana Program

The purpose of this chapter is to determine the operating expenses of the Indiana system. The bottom line in this determination is not the Program's total operating costs, but its net operating costs, i.e., the difference between its total expenses and the total expenses of similar functions in the control states. Like the other study analyses, the question here is: How much higher (or lower) are the Program's expenses than the expenses that would be incurred by a retrospective reimbursement system operating in its place?

In responding to this question, it is necessary to include not only RRC and other expenses clearly identified with the Indiana Program, but also the costs of less visible but still important activities, such as IHA efforts.

This chapter has three sections. The first analyzes the operational costs of the Indiana Program. The second determines the costs of comparable functions in the control states. The third compares the costs of the Indiana and control state programs, and in so doing determines the net operating expenses of the Indiana Program.

The accounting system of Indiana Blue Cross is not ideally suited to determining the Program's operational costs. The entire rate setting function is not treated as a separate cost center, which poses a two-sided problem. First, while the Rate Review Staff is an IBC cost center, it performs activities other than rate setting. Second, in addition to the RRS, other IBC personnel devote time to rate setting functions. It is thus inaccurate to consider the expenses allocated to the RRS cost center as IBC's portion of the Program's operating costs. Rather, such costs must be estimated based upon IBC accounting and other data. For analogous reasons, a similar approach was applied to Blue Cross retrospective reimbursement functions in the control states.

In Indiana and the control states, hospital associations and planning agencies do not use cost centers directed toward rate setting or retrospective reimbursement functions. It is therefore necessary to evaluate the nature of hospital association and planning agency involvement in these functions, and based upon that evaluation, to estimate the costs of this involvement. While this technique is not precise, it is substantially more valid than assuming such involvement entails no costs.

Hospital administrators, financial officers, and other personnel must devote time to meeting the requirements of the Indiana and control state programs. Particularly in smaller hospitals, consulting assistance is often utilized for this purpose. While the expenses of these

activities can be substantial, they are already included in the total cost variable analyzed in Segment I. To avoid double counting, they are not included in this chapter's estimation of the operating expenses of Indiana and control state programs.[1]

Because of data availability, the time period used most extensively in this chapter is fiscal year 1975 (FY 75), i.e., the twelve months from July 1974 through June 1975. It was selected because more extensive and accurate data was available for this year than for any of the main study years. Cost data for other years was also carefully reviewed in order to eliminate the influence of unusual factors occurring in FY 75. Consequently, although this chapter is framed in terms of FY 75, its cost comparisons are generally representative of the operational costs of the Indiana Program during the 1970s.

Since the Indiana Program began in 1960, the operational costs discussed in this chapter do not represent the expenses of starting a new prospective rate setting program. They do encompass not only the day-to-day expenses of reviewing hospitals, but also the costs of maintaining the Program's substantive and political fabric. For example, the recent revision of the Program's guidelines and procedures, embodied in the new Indiana Rate Review Manual, was partially accomplished during FY 75.

Total Expenses of the Indiana Program

In FY 75 the direct expenses of the Rate Review Staff for rate setting functions were approximately $130,000. About 90% of these costs, or $117,000, are labor expenses. The remaining $13,000 includes a variety of nonlabor expenses.

During FY 75 there were 16 Rate Review Committee members, each of whom received a stipend of $50 per monthly session. Since average session attendance was 87%, total RRC stipend expenses were approximately $8,400 during this fiscal year. Total travel expenses for RRC members were $2,200, i.e., an average of $13 per attended session per member. Total RRC expenses are thus $10,600, or rounding to the nearest thousand dollars, $11,000.

The Indiana Program also draws upon two other types of Blue Cross resources. The first and most important is the efforts of Blue Cross executives who are involved in both the Program's routine operation and its overall planning. The second is technical assistance from other Blue Cross departments. These executive/technical expenses are estimated at $25,000.

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[1] An analysis based on Project Survey data indicates that these costs as estimated by hospital administrators are approximately the same in Indiana and control hospitals.

In FY 75 the IBC indirect cost rate was 25% of direct costs. This overhead burden is applicable to RRS costs and to IBC executive/technical expenses, but not to RRC costs. Since the first two items total $155,000, indirect costs allocable to the rate review function are $38,750, or rounding, $39,000.

The Indiana Hospital Association is deeply involved in the Indiana Program. Through its Council on Finance and Reimbursement it is responsible for the periodic revision of the Program's guidelines. Its staff members participate in individual RRC meetings. The direct and indirect expenses of these and similar activities are estimated at $25,000. IHA costs are much lower than IBC expenses since the latter organization provides the main staff support for the Program.

The Indiana Program conditions payment of capital expenses on planning agency approval. It defines capital expenditures in the same way as does the 1122 planning program. In FY 75 the Indiana Program simply accepted planning agency decisions made under the 1122 program. It did not explicitly ask planning agencies to carry out additional activities. From this perspective it can be argued that the additional costs incurred by planning agencies because of the Indiana Program approximate zero. However, a more realistic assumption is that the Indiana Program imposes some additional costs on planning agencies, but that such costs are modest. Accordingly, they are estimated at $10,000.

Table 24-1 summarizes the operational costs of the Indiana Program. As indicated, its total expenses are $240,000. Approximately 85% of these expenses are borne by IBC, with the remainder incurred by IHA and planning agencies. The stipend and travel expenses of the Rate Review Committee -- the most visible component of the Indiana Program -- account for less than 5% of total operating expenses.

Table 24-1

TOTAL EXPENSES OF THE INDIANA PROGRAM

Program Component	Program Expenses
Rate Review Staff	$130,000
Rate Review Committee	11,000
Blue Cross Exec./Technical	25,000
Blue Cross Overhead	39,000
Hospital Association	25,000
Planning Agencies	10,000
TOTAL	$240,000

Although the Indiana Program reviews the costs of other providers, such as long-term hospitals and surgicenters, its dominant focus is the short-term general hospital. Consequently, although the result is a modest overestimate, it is therefore justifiable to allocate all the Program's operating costs to these hospitals. Since the Indiana hospital universe contains 108 institutions, the Program's operating expenses average $2,222 per hospital.

Total Expenses of Control State Programs

As in the other study analyses, in this chapter the three states in the Tristate environment are considered as a single entity. To enhance comparability, both the Michigan and Tristate cost estimates are stated in terms of a hospital universe the same size as Indiana's, i.e., 108 short-term general hospitals. This technique assumes no appreciable economies of scale in either rate setting or retrospective reimbursement activities. This is a valid assumption across the hospital universe sizes in the five study states, which range from 95 hospitals served by Iowa Blue Cross to 258 hospitals served by Chicago Blue Cross.

In the control states the Blue Cross activities analogous to IBC's rate setting program are those functions intrinsic to retrospective reimbursement, i.e., cost auditing and retroactive settlement. These functions are undertaken in both the Michigan and Tristate environments, although Michigan Blue Cross employs much more extensive cost auditing than does Tristate Blue Cross (i.e., the Blue Cross plans in the Tristate area). In addition, the Michigan environment is characterized by capital expenditures review, while the Tristate environment is not.

In Michigan the direct expenses of Blue Cross staff assigned to cost auditing and retrospective settlement approximated $186,000 in FY 75.[2] Tristate Blue Cross costs for these functions were much smaller, about $54,000 which reflects the lower intensity of cost auditing.

Neither Michigan Blue Cross nor Tristate Blue Cross incur costs analogous to the RRC expenses of Indiana Blue Cross. However, both organizations provide executive and technical assistance to retrospective reimbursement functions beyond the general administrative support included in indirect costs. Since the Michigan program is intermediate in complexity between the Tristate and Indiana programs, it is likely that Blue Cross executive/technical costs are higher in Michigan than

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[2] As noted, the control state cost estimates are stated in terms of a 108-hospital universe. To convert this estimate of $186,000 from an Indiana comparison to an actual Michigan estimate, this figure is multiplied by the ratio of 223 to 108, since 223 Michigan hospitals were retrospectively reimbursed during the study time period.

in the Tristate environment, but lower than in Indiana. Accordingly, such expenses are estimated at $10,000 for Michigan Blue Cross and $5,000 for Tristate Blue Cross.

In the study Blue Cross plans the rate review or retrospective reimbursement function is small relative to the organization as a whole. As a consequence, the plan's overhead rate is essentially independent of rate review or retrospective reimbursement activities. Differences in overhead rates should thus not be a factor influencing the estimation of the Indiana Program's net expenses. As a hypothetical example, if IBC's overhead rate were lower than the overhead rate of Michigan Blue Cross, the Program's net expenses should not be lower as a result.

Accordingly, the IBC overhead rate of 25% was applied to the direct expenses of Michigan Blue Cross and Tristate Blue Cross. Since Michigan Blue Cross' direct expenses for retrospective reimbursement functions are $196,000, indirect costs allocable to these functions are $49,000. Tristate Blue Cross' direct expenses for these functions are $59,000, so that applicable overhead costs are $14,750, or rounding, $15,000.

The hospital associations in the control states were not directly involved in the administration of the retrospective reimbursement programs. Nor did the Michigan Hospital Association play a management role in the planning program in that state. Consequently, hospital association costs attributable to the Michigan and Tristate programs approximate zero, as do planning agency costs allocable to the Tristate program. Since the Michigan planning program closely resembled the planning component of the Indiana Program, it is likely that planning agency costs attributable to the Michigan program are approximately the same as those occasioned by the Indiana Program, i.e., $10,000.

Table 24-2 summarizes the operating expenses of the control state programs. As indicated, total operating costs for the Tristate program are $74,000. They are much higher for the Michigan program, equalling $255,000. The operating expenses of the Combined program are also shown in this table. Each Combined cost estimate is calculated as the average of the corresponding Michigan and Tristate figures. Total expenses for the Combined program are $164,000.

Continuing to assume a hospital universe of 108 institutions and the allocation of all operating expenses to short-term general hospitals, the operating expenses of the Michigan program average $2,361 per hospital. The corresponding statistics for the Tristate and Combined programs are $685 and $1,519.

Table 24-2

TOTAL EXPENSES OF THE CONTROL STATE PROGRAMS

Program Component	Tristate Expenses	Michigan Expenses	Combined Expenses
Blue Cross Staff	$54,000	$186,000	$120,000
Rate Review Committee	NA	NA	NA
Blue Cross Exec./Technical	5,000	10,000	7,000
Blue Cross Overhead	15,000	49,000	32,000
Hospital Association	0	0	0
Planning Agencies	0	10,000	5,000
TOTAL	$74,000	$255,000	$164,000

Net Expenses of the Indiana Program

As shown in Table 24-3, the total expenses of the Indiana Program are $240,000 while the total expenses of the Tristate program are $74,000. Since the net expenses of the Indiana Program equal the difference between these expenses, they are $166,000 in the Tristate comparison. The total expenses of the Michigan program are $255,000. Since these expenses exceed Indiana Program costs, the net expenses of the Program are negative in the Michigan comparison, equalling -$15,000.

Table 24-3

NET EXPENSES OF THE INDIANA PROGRAM

	Tristate Comparison	Michigan Comparison	Combined Comparison
Total Indiana Expenses	$240,000	$240,000	$240,000
Total Control Expenses	74,000	255,000	164,000
Net Indiana Expenses	+$166,000	-$15,000	+$76,000

The total expenses of the Combined program are $164,000; the net expenses of the Indiana Program in the Combined comparison are therefore $76,000. On a per hospital basis, the net expenses of the Indiana Program are $1,537 in the Tristate comparison; -$139 in the Michigan comparison; and $704 in the Combined comparison.

In FY 75 Indiana hospital costs (i.e., the total expenses of the Indiana hospital universe) approximated $767 million. The Indiana Program's operating expenses are dwarfed by this figure. This is certainly true in the Michigan comparison where the Program's net expenses are small and negative. Even in the Tristate comparison, where the Program's net expenses are highest, they still equal only .02% of Indiana hospital costs. In the Combined comparison the Program's net expenses comprise .01% of Indiana hospital costs. That is, they equal 1/10,000 of hospital costs in the state.

Since the Indiana Program's operating expenses are minute compared to hospital costs in that state, any appreciable cost savings produced by the Program will swamp these expenses. This conclusion has three important implications. First, the crucial issue for both the operation and evaluation of a prospective rate setting program is whether the program has a significant impact on hospital cost. If present, such an impact will almost certainly far exceed the program's operational costs. Even if the Indiana Program's net expenses had been $1 million, i.e., far higher than its net expenses in any of the comparisons, they still would have equalled only .13% of Indiana hospital costs. A 5% or 10% impact on hospital costs will thus overwhelm even $1 million in operating expenses.

Second, while it is desirable to accurately estimate the operating expenses of Indiana and control state programs, substantial misestimation would not change the central conclusion of these analyses. For example, the expenses of IHA's efforts devoted to the Indiana Program are estimated at $25,000. If this estimate were 100% in error, it would make no difference in terms of the main analysis findings. That is, if IHA's costs were $50,000 or zero rather than $25,000, the Indiana Program's expenses would still constitute a very small fraction of total Indiana hospital costs. This chapter's central conclusion is solid since it is thus independent of even sizeable misestimates of specific operating expenses in Indiana or the control states. The same point holds for substantial fluctuations in particular operating costs from year to year.

Third, the critical question for any hospital cost control technique (e.g., total budget review, peer group comparisons, or detailed data requirements) is not the cost of using the technique, but the likelihood that the technique will reduce hospital cost (without producing adverse side effects). If this likelihood is substantial, the technique should be employed since its probable cost savings will outweigh its operating expenses. Conversely, if this likelihood is low or

highly uncertain, the technique should not be used unless its operating costs are so low that they are only a minor consideration.[3]

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[3] This point undercuts a presumed advantage of rate setting by means of a formula: the lower operating costs of such an approach. Further, Cromwell et al. (1976b) estimate that the total operating expenses of the New York program -- the prime example of a program using formulary rate setting -- are approximately $2,000 per hospital in FY 75, i.e., about the same as the total operating expenses of the Indiana Program.

IX.

Principal Findings

The chapters is this section form an integrated whole. Their common purpose is to discuss the major study results and the implications of those results.

Chapter 25 concentrates on the Program's influence in Indiana, integrating the findings described earlier. Chapter 26 looks beyond Indiana to determine if the Program can be replicated elsewhere. In so doing it attains the seventh study objective.

Chapter 27 returns to this study's three-dimensional purpose described in Chapter 1. It concisely reviews the evidence germane to the first two dimensions, but its main focus is the third. That is, the chapter's primary function is to derive conclusions generic to the process of controlling hospital costs.

25.
Overall Impact in Indiana

This chapter synthesizes the results described in the preceding five sections. In so doing it has two purposes. The first is to concisely summarize the Program's effects in Indiana. The second is to derive the Indiana system's net benefit based upon the nature and magnitude of its effects.

The chapter is framed in terms of the study objectives defined in Chapter 1. It opens by considering the evidence germane to the first objective. The chapter then sequentially reviews the findings relevant to the next four objectives. It closes by delineating the Program's net benefit, thereby attaining the sixth objective.

As discussed earlier, the Michigan and Tristate results are generally similar. Accordingly, in earlier chapters the Combined results are frequently used to summarize the study findings. The same approach is taken in this chapter, but to an even greater extent. While the Michigan and Tristate findings were considered in developing this summary chapter, all specific results described in the chapter are drawn from the Combined analyses.

Impact on Hospital Costs

The Indiana Program achieves its foremost objective in that it has a strong negative influence on total hospital cost. The regression analyses show that its effect rises steadily during the main study years, increasing from -4% in 1968 to -10% in 1973. During the intervening years its impact is -5% in 1970 and -10% in 1972. Consistent with these results, the Program exerts a negative influence on the percentage change in total cost between 1968 and 1973.

The Indiana system's influence during the main study period in terms of dollars is summarized in Table 25-1. The first column in this table shows the Program's dollar impact on total cost (i.e., cost per case). For the four main study years -- 1968, 1970, 1972, and 1973 -- this statistic is derived directly from the regression analyses. For the other two years, 1969 and 1971, it is estimated based on the Program's impact in the main study years. Straight-line interpolation was the technique employed. Accordingly, the 1969 value equals the average of the 1968 and 1970 values, and the 1971 value is the average of the 1970 and 1972 values.

Table 25-1

HOSPITAL COST SAVINGS OF THE INDIANA PROGRAM
DURING THE MAIN STUDY PERIOD

	Impact on Cost per Case	Indiana Hospital Cases	Hospital Cost Savings
1968	-$16	670,000	$10,720,000
1969	-$23	688,000	$15,824,000
1970	-$29	712,000	$20,648,000
1971	-$49	733,000	$35,917,000
1972	-$69	747,000	$51,543,000
1973	-$80	777,000	$62,160,000

The second column in the table indicates the number of inpatient cases treated by the 108 institutions in the Indiana hospital universe. As discussed previously, the study findings can be generalized to that universe. The Program's impact on cost per case therefore applies to the total cases treated by the universe. Accordingly, the Program's hospital cost savings shown in column three equal the product of columns one and two (i.e., the Program's impact on cost per case multiplied by the number of cases).

In 1968 the Program's hospital cost savings are modest compared to later years, but they are still substantial, equalling almost $11 million. In 1970 its dollar savings are almost double those in 1968, approximating $21 million. During the next two years the increase is even sharper; its 1972 dollar savings of about $52 million are almost five times as high as its 1968 savings. In 1973 the Program's savings are greater yet, approximating $62 million.

During the main study period the hospital cost savings of the Indiana Program equal the sum of its cost savings in the individual years, or

$196,812,000. That is, during this period alone the Indiana system achieved cumulative hospital cost savings of almost $200 million.[1]

The time trend findings broaden the regression results. They show that the Indiana system's effect on cost has progressively risen from the early 1960s through 1976. During this time period the Program's cost influence has expanded in both percentage and dollar terms, with the increase particularly marked in dollar terms because of the substantial inflation in hospital costs.

The Indiana system's hospital cost savings cannot be determined as precisely from the time trend findings as from the regression results. Nonetheless, the former can be employed to estimate the probable range of the Program's cost savings both before and after the main study time period. The methodology used for this purpose has five steps.

First, as described in Chapter 12, during the main study years there is a consistent difference between the percentage difference in the time trend analysis and the percentage impact in the regression analysis. The average difference between these results equals -5.75%, or rounding, -6%. As an approximation, this difference can be used as a correction factor to transform the percentage difference findings in the non-main study years to percentage impact results. For example, applying the -6% correction factor to the 1962 percentage difference of -11% yields a percentage impact of -5% in that year.

Second, for total cost as well as for most dependent variables, the control hospital mean approximates the denominator of the percentage impact statistic, i.e., $\bar{Y}_C \approx \bar{Y} - B_I\bar{Y}_I$. Accordingly, as an approximation, in the non-main study years the Program's dollar impact equals

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[1] As indicated in the discussions, but to emphasize the point, the Program's cost savings in each study year are achieved in that year alone. They do not represent a cumulative figure. For example, the Program's cost savings of $52 million in 1972 and $62 million in 1973 do not mean that the Program had achieved cumulative savings of $52 million through 1972, and then produced an additional $10 million saving in 1973. Instead, these results indicate that the Indiana system saved $52 million in 1972, and an additional $62 million in 1973.

This discussion does not imply that a program's cost savings in one year are not influenced by its cost performance in preceding years. To illustrate this point, consider two wheat farms. If the cost per bushel in year one is substantially lower for Farm A than for Farm B, the cost performance of Farm A is likely to also be superior in year two. The same principle holds for prospective rate setting programs. If a program substantially reduces cost in year one, it is more likely to achieve sizeable cost savings in year two than if its cost impact were insignificant in the first year.

average control hospital cost (shown in Table 12-4) multiplied by the Program's percentage impact calculated in the previous step. Continuing with the 1962 example, the Program's dollar impact in that year equals the control mean of $253 per case multiplied by the Program's percentage impact of -5%, or -$13 per case.

Third, since there were no sharp changes in Indiana demographics between 1960 and 1976, it is reasonable to assume that the change in Indiana hospital cases outside the main study years resembles that within those years. Hence, as an approximation, Indiana hospital cases in the non-main study years can be estimated by using the average rate of change in cases during the main study period. For example, invoking this technique, cases in 1974 equal the 1973 total of 777,000 multiplied by 103.2% (100% plus 3.2%, the average annual rate of increase between 1968 and 1973), or 802,000.

Fourth, as shown in Table 25-1, during each main study year the Program's hospital cost savings equal its dollar impact multiplied by the number of Indiana hospital cases. Upon completion of the second and third steps described above, the same technique can be applied to the non-main study years. The results are displayed in Table 25-2.

Table 25-2

HOSPITAL COST SAVINGS OF THE INDIANA PROGRAM
OUTSIDE THE MAIN STUDY PERIOD

	Impact on Cost per Case	Indiana Hospital Cases	Hospital Cost Savings
1961	0	539,000	0
1962	-$13	557,000	$7,241,000
1963	-$8	576,000	$4,608,000
1964	-$11	595,000	$6,545,000
1965	-$6	614,000	$3,684,000
1966	-$3	632,000	$1,896,000
1967	-$27	651,000	$17,577,000
1974	-$122	802,000	$97,844,000
1975	-$98	827,000	$81,046,000
1976	-$126	852,000	$107,352,000

As indicated in the table, the Indiana Program did not produce a significant cost saving in 1961. However, between 1962 and 1967 its average cost savings equal $6,925,000 per year. During the three years after 1973 its annual cost savings average $95,414,000. In 1976, the most recent year included in the study, the Indiana system's cost savings equal $107,352,000.

Fifth, as noted earlier, time trend findings are not as accurate as regression results. It is therefore more appropriate to state the Program's cost savings in the non-main study years as ranges rather than as point estimates. While the point estimates shown in Table 25-2 are clearly approximations, it is nonetheless likely that they are accurate within at least a 25% margin of error in either direction. Adopting this margin of error, and rounding to the nearest million away from the mean, the Program's average annual hospital cost savings between 1962 and 1967 range between $6,925,000 times 75% and $6,925,000 times 125%, or between $5,194,000 and $8,656,000, or between $5 million and $9 million. The same technique was used to calculate ranges for the Program's cost savings in 1976 and for its average annual cost savings between 1974 and 1976.

Therefore, based upon this five-step methodology, the hospital cost savings of the Indiana system average between $5 million and $9 million per year during the six-year span from 1962 through 1967. Further, the Program's average annual cost savings during the three years between 1974 and 1976 are much larger, ranging between $71 million and $120 million. In 1976, the last time trend analysis year, the cost savings of the Indiana Program range between $80 million and $135 million, clearly exceeding its cost savings during any of the main study years.

Pathways of the Program's Cost Influence

As an overview, the regression findings indicate that the Indiana Program's dominant effect is on the hospital's use of labor resources. It impacts total cost primarily by influencing labor cost. The labor cost effect is produced by an impact on both average salary and labor productivity, which together determine labor cost. The Program also affects the hospital's use of supplies and services, and reduces total cost by decreasing supply/service cost. It has little influence on the hospital's utilization of capital resources, and does not decrease total cost through this mechanism in any study year.

Within this overall picture, the Indiana system's specific effects change significantly during the study period. In 1968 the Indiana Program influences total cost solely through its impact on labor cost, which is entirely due to its influence on average salary. In that year its influence on capital cost is in fact positive, thereby partially offsetting its negative impact on labor cost. In 1973 the Indiana Program reduces total cost by exerting a negative influence on both labor cost and supply/service cost. Its impact on the former

is greater than its influence on the latter. The 1973 labor cost effect arises through the Program's impact on both average salary and labor productivity. Even in this year the Indiana system does not lower total cost through capital cost.

The Program's effects on labor cost and supply/service cost are almost equally responsible for the accelerating influence on total cost between 1968 and 1973. The rising labor cost effect is largely produced by the Program's increasing impact on labor productivity, but its continuing influence on average salary is also important. The Indiana system's effect on capital cost makes a marginal contribution to the increasing impact on total cost since it changes from positive in 1968 to insignificant in 1973.

These results are summarized in Table 25-3. A downward arrow in this table means that the Program exerts a negative influence on total cost through the indicated variable. An upward arrow has the reverse connotation, while a zero signifies that the Program has an inappreciable impact on total cost through the particular variable. The number of arrows indicates the approximate magnitude of the effect.

Table 25-3

PATHWAYS FOR THE PROGRAM'S IMPACT ON TOTAL COST

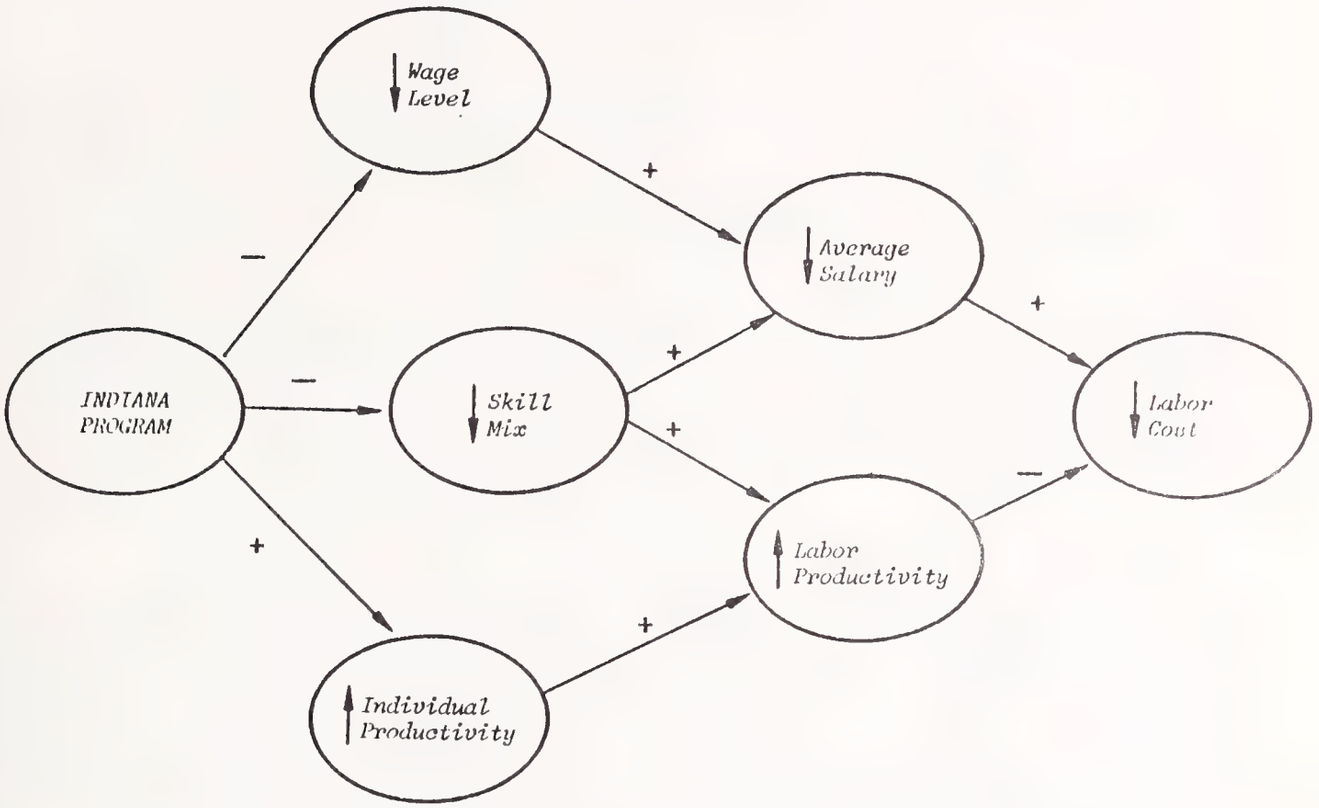
	Labor Cost		Supply/ Service Cost	Capital Cost
	Average Salary	Labor Prod.		
1973	↓↓↓↓	↓↓↓	↓↓↓↓	0
1968	↓↓↓	0	0	↑
Change between 1968 and 1973	↓	↓↓↓	↓↓↓↓	↓

Figure 25-1 depicts the Indiana Program's influence on the labor sector. In this figure the horizontal arrows indicate the direction of an effect, and the adjacent pluses and minuses denote whether the effect is positive or negative. The vertical arrows show whether the Program's overall impact on the indicated variable is positive or negative. As discussed below, in some instances the Program's overall

impact is due to a single effect, while in others it is the result of several effects.

Figure 25-1

PROGRAM'S INFLUENCE ON THE LABOR SECTOR



As indicated in the figure, average salary is determined by wage level and skill mix, with these variables having positive effects on average salary. Labor productivity is determined by skill mix and individual productivity, both of which have a positive effect on labor productivity. The Program's impact on wage level is negative (produced to some extent by its negative influence on unionization). Its influence on skill mix is also negative. Both the wage level and skill mix effects thus contribute to the Program's negative impact on average salary.

The Indiana system's negative effect on skill mix decreases labor productivity. However, its impact on individual productivity is positive and sufficiently strong to override the negative skill mix effect. The Program's impact on labor productivity is therefore positive.

As noted earlier, labor cost is determined by average salary and labor productivity, with the former having a positive influence and the

latter a negative impact. Since the Program's impact on average salary is negative and its influence on labor productivity is positive, its effects on both variables decrease labor cost and are thus responsible for its negative impact on this cost.

In contrast to its pervasive influence on the labor sector, the Indiana Program's impact on the capital sector is limited. Its influence on capital expenditures is insignificant; its impact on capital productivity is positive but distinctly weaker than its influence on labor productivity. Further, the Program has insignificant effects on the percentage changes in capital intensity and bed size.

The Indiana Program does not impact hospital cost even in part by influencing physician-oriented variables such as case intensity and quality. Similarly, it does not affect cost by impacting service mix. In addition, its cost impact is not produced by an effect on shared/contracted services.

The Indiana system exerts a negative influence on all three departmental costs -- nursing cost, ancillary cost, and administrative/hotel cost. No major department is thus immune to its influence. Consistent with its dominant influence on labor cost, the departmental cost most strongly affected by the Indiana Program is nursing cost.

Side Effects

In general, the regression results show that the Indiana Program has an inappreciable impact on physician-dominated variables. Specifically, it exerts an insignificant influence on all three case intensity variables -- case mix, case severity, and elective surgery. Similarly, it has an insignificant effect on the two patient mix variables: elderly caseload and white caseload. Further, its impact on utilization practices is insubstantial. Reflecting these findings, the Program has an insignificant influence on length of stay, a fundamental measure of hospital utilization.

Critically important is the finding that the Indiana Program's impact on quality is insignificant. Consistent with these results and with the capital utilization findings, the Program has an insignificant impact on both specialized service mix and basic service mix.

There is thus no evidence that the Indiana system damages the effectiveness of hospital care -- a possibly fatal side effect if it were present. The cost reduction achieved by the Program is consequently a pure efficiency effect. That is, costs are lower, but the nature of hospital output is unchanged. The same kinds of patients are given the same type and quality of care in Indiana hospitals as in control hospitals, but at a lower price.

The study findings also show that the Indiana Program has not substantially depleted the financial resources of hospitals, another potentially important side effect. Its impact on net worth is insignificant as is its influence on working capital. It does have a negative impact on profit margin, but this effect is relatively inconsequential because this variable is the least accurate indicator of the hospital's real financial position.

Influence on Hospital Management

The site visit findings indicate that the Indiana Program impacts hospitals by influencing the administrative staff in general and the administrator in particular. It achieves its effects partially through financial incentives, but primarily through professional incentives.

The Program is directed toward the management of the hospital; its major focus is on the justifiability of costs from a management perspective. Because hospitals feel they have a voice in the Program and because the Program is regarded as tough and well-informed, but still equitable, it is widely respected by Indiana hospitals. As a consequence, through its review procedures the Indiana system is able to reinforce the inherent desire of most administrators to be efficient managers. Primarily through this mechanism the Indiana Program achieves its goal of increasing the efficiency of hospital care, thereby decreasing the rate of hospital cost inflation.

The largest share of the Indiana Program's cost savings is produced by a positive effect on hospital management. This improvement in management is due to three intertwined elements: greater cost consciousness, improved planning and budgeting, and careful decision making based on evaluation of cost trade-offs.

The next largest fraction of the Program's cost savings results from the process of preparing rate requests. The linchpin here is that, unlike a retrospective reimbursement environment, the projected budget is a binding document in Indiana since it is the basis of the hospital's rates. The smallest percentage of the Program's savings is achieved by specific RRC or RRS actions. However, the possibility of such actions is the deterrent which enables the Indiana system to achieve larger savings through the other two mechanisms.

In contrast to its impact on the administrator, but consistent with the other study findings, the Indiana Program has little effect on the physician staff. This is especially true in terms of patient management since both the site visit findings and the regression results indicate that the Program has not influenced the way physicians practice medicine.

The Indiana system does not impact the administrator primarily by influencing the hospital board. In fact, it has little direct contact

with the board. Even so, the presence of the board, which is often composed largely of community representatives, reinforces the professional and financial incentives of the Program.

The Program unquestionably enhances the position of the financial officer, but this finding should not be misconstrued to mean that it is accounting-oriented, rather than management-oriented. As an extension of its effects on the administrator and financial officer, the Indiana system increases the cost consciousness and managerial involvement of department heads.

The Indiana Program has an insignificant impact on the basic credentials of administrators and financial officers: their education, tenure, and experience. Its influence on hospital management thus does not have as a prerequisite a substantial change in these characteristics. The Program is able to improve hospital management in Indiana by working with individuals whose credentials are similar to those of their counterparts in the control hospitals.

Operating Expenses

The Indiana Program's total annual expenses are substantial, but not high: $240,000 or approximately $2,200 per Indiana hospital. These expenses include not only the costs borne by Indiana Blue Cross, but also those experienced by the Indiana Hospital Association and Indiana planning agencies. The costs directly attributable to the Rate Review Committee are low, equalling $11,000 or less than 5% of the Program's total expenses.

There is a sizeable difference between the expenses of the control state retrospective reimbursement programs. As a consequence, the net expenses of the Indiana system vary considerably in the Michigan and Tristate comparisons, equalling -$15,000 in the former and +$166,000 in the latter. In the Combined comparison the net expenses of the Indiana Program are +$76,000 or a modest $704 per hospital.

Net Benefit

The Program's net benefit in Indiana is strongly positive -- a result which stems from its negative impact on hospital costs. The hospital cost savings produced by the Program are large throughout the main study time period, approximating $62 million or almost $600,000 per hospital in 1973, the last main study year. In contrast, the net operating expenses of the Indiana Program are almost trivial, equalling about 1/1,000 of its hospital cost savings.

The Indiana Program does not produce undesirable side effects. It does not lower the quality of hospital care nor does it adversely affect the nature of hospital output in other ways. It does not reduce

the range of services offered by Indiana hospitals. Further, the Program does not threaten the financial viability of hospitals.

As is its intent, the Indiana system impacts the hospital by influencing the administrative staff. Most of its cost savings arise through improved hospital management and through hospital preparation of the rate request, rather than through direct RRC/RRS actions. This result is favorable since it means that the Program induces desirable changes in hospital behavior, instead of serving solely as a policing agency penalizing hospitals.

The Indiana Program's dominant impact is on labor cost -- a result consistent with its strong emphasis on the hospital's labor sector. It also affects the use of supplies and services, and thereby reduces supply/service cost. Its influence extends across the three major hospital departments: nursing, ancillary, and administrative/hotel. All of these results are favorable and reflect the Program's objectives.

An unfavorable finding is that despite its planning component the Indiana Program does not exert a sizeable influence on the capital sector. Its impotence in this area does not, however, constitute a cost since it does not have a positive influence on capital expenditures. Instead, the Program's effect on hospital utilization of capital resources is essentially neutral, which means that this is one area where the Indiana system fails to produce a benefit.

The Indiana Program satisfies all three parts of the general hypothesis enunciated in Chapter 1 for prospective rate setting programs. It sharply reduces hospital cost inflation; it does not adversely affect the effectiveness of hospital care; and it does not incur inordinate expenses. The study findings therefore indicate that the Program is a solid success in Indiana.

26.
Replicability Outside Indiana

The previous chapter establishes that the net benefit of the Indiana Program is strongly positive. It is therefore essential to pursue the seventh study objective, i.e., to determine the Program's replicability in other settings. If the Program is a phenomenon unique to Indiana, it would be expected to continue to benefit the people of that state, but this study's implications for other states would be diminished. Conversely, if prospective rate setting programs similar to Indiana's can function effectively elsewhere, the strong implication of this study is that they could produce substantial benefits.

Like any regulatory system, the Indiana Program has a number of characteristics. Many make marginal contributions, but are not essential to the Program's success. Others are sufficiently critical that their elimination would threaten the Program's effectiveness. These features constitute the minimum set of characteristics which another rate setting system must have to permit generalization of this study's findings to that system. If these essential features are absent, the study findings do not provide a clear-cut basis for predicting the system's success. In contrast, if these features are present, the study findings provide solid evidence supporting the system's potential effectiveness, although they do not guarantee its success.

In short, it is not necessary to replicate the entire Indiana Program to reap its potential benefits. Only the Program's essential features need be duplicated. The first chapter task is to review the Program's central characteristics and to delineate those features which seem indispensable to its success.

The second task is to examine factors influencing the Program's replicability. It is crucial to determine whether factors exist which have two properties: uniqueness to Indiana and indispensability to the Program. For example, do any socioeconomic characteristics of Indiana have both properties? If so, they would block replication of the Program in other settings. It is also important to examine factors facilitating or impeding, but not totally blocking, the Program's replicability.

In addition to the Indiana Program, there are a number of prospective rate setting programs in this country. Some may incorporate the essential features of the Indiana Program. If so, they furnish tangible evidence of the Program's replicability. The third chapter task is to ascertain whether such programs exist.

The first three chapter tasks provide related but distinctly different types of evidence. Accordingly, the final task is to integrate these diverse findings and to thus determine the Program's replicability in other settings.

Essential Features of the Program

One essential characteristic of the Indiana Program is the balanced objectives which together constitute its purpose. On the one hand, it is the clear and serious intent of the Program to reduce hospital cost inflation. The Indiana Program is not a facade designed to give the appearance of worthwhile activity, but with the actual intention of exerting little influence on hospitals. On the other hand, the Program strives to control hospital costs not by forcing indiscriminate cost-cutting, but by making the provision of hospital services more efficient. Both elements of the Program's purpose are necessary ingredients to its success.

Another necessary feature is that adherence to the rates set by the Program is essentially compulsory for Indiana hospitals. The Indiana Program's compulsory nature imparts four significant advantages. First, grossly inefficient hospitals cannot ignore the Program. Second, even well-managed hospitals may at times disagree with specific Program decisions. In such instances they cannot simply defy the Program and raise their rates -- a course which may seem appealing at the time. Third, the free rider problem which plagues voluntary efforts is resolved.[1] Fourth, Indiana hospitals cannot dismiss the Program as a noble but powerless effort.

To establish rates the Indiana system reviews and agrees upon the aggregate percentage increase in hospital rates, which is drawn directly from the projected hospital budget. These rates cannot be circumvented by a hospital through the practice of shifting costs among payers. Together these two characteristics mean that the binding unit of negotiation under the Indiana Program is the total hospital budget -- another indispensable Program feature. Given this feature, it makes only a modest difference whether hospitals are paid on the basis of charges, per diems, or budget aliquots. Accordingly, the fact that hospitals are paid charges under the Indiana Program is not an essential characteristic. However, a related feature is necessary: It is

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[1] This problem arises because individual hospitals (except for the largest institutions) can legitimately feel that their cost behavior has an inappreciable impact on the joint goal -- control of hospital costs in Indiana. Individual institutions may thus elect to act as free riders, letting other hospitals achieve the joint objective. The nub of the problem is that under a voluntary program many hospitals may act in this way with the result that the joint goal is not attained.

essential that hospitals are paid on the basis of prospectively established rates.

The Indiana Program has a 20-member Rate Review Committee and a strong Rate Review Staff. It draws upon the skills of IHA's staff and membership, especially for the periodic review of guidelines and procedures. In addition, the Program is assisted by the efforts of IBC executives and Indiana planning agencies. It is thus evident that sufficient resources are allocated to the Program, which constitutes another indispensable characteristic.

Indiana hospitals regularly submit an annual rate request. As a consequence, once a year the administrative staff is called upon to justify the hospital's costs and their planned actions. Such justification is an integral part of preparing the rate request. It may be even more explicitly required if the hospital discusses its case with the Rate Review Committee. The intertwined elements of this process jointly constitute an essential characteristic of the Indiana Program. One is emphasis upon the justifiability of costs from a management perspective; the other is periodic review of the hospital with the intent to systematically reinforce this emphasis.

One of the Program's most visible facets is its planning component. For years the Indiana system has conditioned the payment of capital expenses on planning agency approval. However, in contrast to its strong effects on the labor and supply/service sectors, it has little influence on the capital sector. The Program's cost savings thus do not arise from an impact on hospital utilization of capital resources. Consequently, while the planning component is a central characteristic, it is not one of the Program's essential features.

The main sponsors of the Indiana Program are Indiana Blue Cross and the Indiana Hospital Association. Partially because of the latter's involvement, the Program has the strong support of individual hospitals. Tangible evidence of this support is the fact that the Indiana system has never been sued by a hospital. The Program is formally lodged in Indiana Blue Cross, which provides the full-time staff and pays the stipends/expenses of the Rate Review Committee. The meetings of the Committee are informal and nonlegalistic; they are not open to the public.

The Committee is composed of part-time provider and public members. The former are active hospital administrators or financial officers; the latter represent a wide diversity of backgrounds and interests. Three of the public members are selected by the Indiana HSAs and one is chosen by the state's Governor. There are no other explicit links with the state (or federal) government.

The question thus arises: How much of this organizational structure is essential to the Indiana Program? It is clear that small changes would not undermine the Program's effectiveness. As one example, it

is unlikely that the Program would function much differently if the Governor appointed three RRC members rather than one. As another, it is improbable that the Program's success would suffer if the hospital association or individual hospitals paid one half of the RRC/RRS expenses. As still another, it is likely that RRC meetings could be opened to the public since this step alone would not transform them into legalistic and sharply adversarial proceedings.

Given the current political environment, the central issue from the standpoint of organizational structure is to what degree the state government could be brought into the Program without irrevocably changing it. Program participants generally agree that provided that the Indiana system retains its essentially compulsory nature, it need not be located in Indiana Blue Cross to be effective. In fact, informal but serious consideration has been given to increasing the distance between the Program and Blue Cross, with one possibility being the creation of a separate nonprofit corporation to house the Program. It is further acknowledged that if such a corporation were created, the Indiana Program would not be seriously damaged and might even be enhanced if the state government became an active, but not dominant, partner. Similarly, it is likely that greater state government participation would not weaken the Program in its present locus.

However, it is widely felt by Program participants that if the Indiana Program were taken over by the state government and operated as a state agency, its effectiveness would rapidly deteriorate. The rationale supporting this judgment is fourfold.[2] First, the Program would probably become more bureaucratic, i.e., there would be more paper shuffling and less individual responsiveness. Second, in the words of a Program participant, "Our system might become enmeshed in picayune politics" -- a possibility avoided to date.

Third, the RRC meetings might well assume a public hearing atmosphere, which most Program participants feel would be deleterious.[3] According

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[2] Bauer (1978) points out that a significant impediment to some state programs is "the familiar bricks-without-straw phenomenon, where state legislatures pass laws that require state agencies to perform new functions, but fail to pass the budgets that are needed for proper implementation." This possibility is not cited by Indiana Program participants as a potential drawback to state government takeover. However, it could well occur in Indiana given the state government's traditional fiscal conservatism.

[3] Cohen (1978) describes a case which suggests that the hearings of a state cost commission may assume a courtroom atmosphere even if the commission prefers otherwise. He cites the commission's need to build a sound record in the event the hospital should appeal the case to the courts. As he puts it, "Building a record appears to require all-out adversary-type hostility or else the hospitals will win their appeals."

to an RRC member: "A courtroom atmosphere would be very unfortunate." Fourth, the Program would probably become less flexible; its posture would change from negotiating with hospitals to simply telling them what to do. As one RRS member put it:

> I worked for the state government before coming to Blue Cross. In my experience state government and private sector employees just think somewhat differently. I suspect that if we were to become a state system, I would be more dictatorial.

According to Program participants, these likely changes under the state's aegis would probably have two major consequences, both of which would sharply constrain the Program's future success. One is that the Program would slow of its own inertia: It would become less concerned with outcomes and more involved with processes. The other is that the Program would lose the respect of Indiana hospitals. It is widely acknowledged that hospital support is an essential ingredient in the Program's success. As expressed by an RRC member: "A key factor making our system work is that hospitals want it to work."

Two overall points emerge. One is that the Program's entire organizational structure is not essential to its success. The other is that wholesale changes, especially in the direction of total government takeover, could markedly diminish the Program's success. At a minimum it cannot be asserted with confidence that such changes would not reduce the Program's effectiveness. This being the case, what are the organizational characteristics which appear essential to the Program's success?

First, there is substantial private sector involvement in the Indiana Program, including both hospitals and third-party payers. More precisely, it appears essential to the Program's success for the private sector's influence to at least equal the government sector's. Second, the Indiana Program is not totally dominated by providers. Instead, extensive and broad-based nonprovider involvement is present. Third, the Indiana Program enjoys solid individual hospital support. Fourth, the Program is flexible and basically informal, avoiding strict adherence to bureaucratic procedures.

Factors Influencing Replicability

An important consideration for the replication of any system is whether it is an "Alexander the Great phenomenon." That is, is a single outstanding individual, or several such people, so critical to the system that it would be much less effective in his or her absence? If so, the system may not be replicable at all.

Without doubt the Indiana Program has benefited from the contributions of talented people. Further, it has been characterized by strong

continuity over time. Individuals have occupied leadership roles for substantial periods of time, and turnover has been gradual and planned. Even so, prevailing opinion in Indiana holds that no single individual is so key that the Program would falter in his/her absence.

Tangible evidence of this point is that the Program has experienced considerable turnover during the 1970s without untoward effect. Thirteen of the RRC's present 20 members have served on the Committee for less than five years. Robert Jones, who spearheaded IBC's involvement in the Program for many years, now plays a more distant role. To a lesser extent, the same is true for Elton TeKolste, who has overall responsibility for IHA's participation in the Program.

Another critical question concerning the replicability of any system is whether there is something in the system's environment which is sufficiently unique to constrain replicability. That is, is there anything unique about Indiana as a state which blocks the Program's replication elsewhere?

In this regard the critical issue is whether Indiana and other states are sufficiently similar in terms of exogenous variables, since it is such variables that constitute the framework within which a prospective rate setting system must work. Table 26-1 compares Indiana with the Midwest and the United States in terms of nine important local exogenous variables. All these variables were included in the study regression analyses and are described in earlier chapters. Seven are socioeconomic characteristics of the population; the remaining two are physician characteristics.

Table 26-1

COMPARISON OF INDIANA
WITH MIDWEST AND UNITED STATES

Physician and Socioeconomic Characteristics	Indiana Average	Midwest Average	United States Average	10th percentile for the US	90th percentile for the US
Physician Concentration	78	83	98	71	118
Gen. Practitioner Conc.	28	23	23	18	31
Income Level	$9966	$10,112	$9586	$7446	$11,057
Farm Population	7%	7%	4%	.4%	13%
Urban Population	65%	71%	73%	45%	86%
White Population	93%	91%	88%	74%	99%
Education Level	12.1	12.1	12.1	10.6	12.4
Pediatric Population	8.8%	8.5%	8.4%	7.9%	9.4%
Elderly Population	9.5%	10.3%	10.1%	7.4%	12.1%

In terms of these variables Indiana resembles the Middle West. There are differences between Indiana and the United States. For example, physician concentration is lower in Indiana and farm population is higher. However, the most significant finding is that for all nine variables Indiana falls between the 10th and 90th percentiles for the United States.[4] The socioeconomic and physician characteristics of Indiana are thus not so extreme as to constrain the Program's replicability.

A sound index of the size of a prospective rate setting program is the magnitude of the population covered.[5] Indiana's population is the 12th largest in the United States. As a consequence, the Indiana Program which covers the entire state is large. However, as with other socioeconomic characteristics, the population differences between Indiana and most states are not extreme. Accordingly, state population size and thus program size do not constitute a barrier to the Program's replicability. For example, while Illinois has approximately twice as many people as Indiana and while Iowa has about half as many, an Indiana-type program would appear feasible in both states.

Further, the Indiana Program appears to be a workable approach in states with small populations, such as the two Dakotas. Even in large states, such as California and Texas, a program embodying the Indiana Program's essential characteristics seems a viable alternative on the basis of program size alone.

An indispensable Program characteristic is substantial involvement by the private sector. This feature will be more easily attained in those states with a less expansive public sector and/or with a history of joint public/private enterprises. If there is a tradition of antagonism between the public and private sectors, especially in the health care area, it will be particularly difficult to establish an Indiana-type program.

Administration by Blue Cross is not a necessary ingredient of the Indiana Program. However, as in Indiana, a Blue Cross plan can be a

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[4] The 10th (or 90th) percentile is defined as the value for a particular variable exhibited by the state which exceeds 10% (or 90%) of the states in terms of the variable.

[5] For two reasons population size is a valid measure of program size. First, it is not influenced by the program's actions. Second, it strongly reflects the amount of hospital care delivered under the program.

point of coalescence for the development of an Indiana-type program.[6] This process will be facilitated if there is a single Blue Cross plan in the state and/or if the Blue Cross penetration rate is high. Similarly, it will be easier to establish an Indiana-type program if the state has a strong hospital association. Such a step will also be enhanced if the Blue Cross plan and the hospital association have a good working relationship. Finally, as an obvious but nonetheless important point, an Indiana-type program will be more effective in those settings where bright and motivated individuals are involved.

A remaining issue is lifestyle and other elements of the socio-psychological climate. While this dimension is difficult to measure precisely, it is likely that this climate is similar throughout the Middle West. Accordingly, the socio-psychological character of Indiana, denoted at times by the term "Hoosier personality," is probably not markedly different from those of other Midwestern states, such as Michigan, Wisconsin, or Nebraska.

It is possible that on this dimension there are distinct differences between the Middle West and the other three major regions of the country. Conceivably, these possible differences are large enough to affect the Indiana Program's replicability, but this seems unlikely in most instances.

Again, the rationale is that Indiana is not an outlier in the United States. For example, its socio-psychological climate appears to be basically similar to those of such diverse states as Oklahoma and Georgia in the South, Pennsylvania and New Hampshire in the East, and Washington and Colorado in the West. While important lifestyle differences exist between Indiana and these states, these differences by themselves do not seem of sufficient magnitude to affect the viability of a prospective rate setting program.

Similar Programs in Other States

A number of prospective rate setting programs in other states exhibit the essential features of the Indiana Program.[7] One is the Wisconsin

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[6] Although it occurs less frequently, a commercial insurer can also serve as a point of coalescence. An example is the role played by Bankers Life in the evolution of the Iowa program. Further, as exemplified by the efforts of the Motorola Company in Arizona, private industry can provide a strong stimulus to the development of hospital cost control programs.

[7] To characterize the programs described in this section, telephone interviews were conducted; written program descriptions were reviewed; and if available, other pertinent documents and reports were examined. In each instance emphasis was placed upon determining not only the characteristics of the program on paper, but also how the program works in practice.

program, which was instituted on an experimental basis in 1972 by the Blue Cross plan and the hospital association. Substantial evolution has occurred since that time and the program is now a joint private/public system which is compulsory for all Wisconsin hospitals.

In its present form the Wisconsin program is highly similar to the Indiana Program, with the most significant difference being the former's explicit inclusion of the state government. In Wisconsin the 20-member Rate Review Committee is selected by Blue Cross, the hospital association, and the state government. Six members are appointed by each organization, with the remaining two members chosen jointly by the hospital association and the state government. The Wisconsin program covers Medicaid beneficiaries as well as all nongovernment patients.

The prospective rate setting program in Southwest Ohio is a Blue Cross system, although its rates also apply to other nongovernment patients. While less formal than the Indiana Program, it has all the Program's essential characteristics. The Southwest Ohio system is even older than the Indiana Program, being established in 1942. Hospital association involvement is less pronounced in the Southwest Ohio plan, but the system still enjoys the solid support of individual hospitals. An important factor engendering this support is the extensive activities of the rate review staff, whose role is even stronger in this program than in the Indiana Program.

The Rhode Island system is a joint effort of the private and public sectors. It is much smaller than the Indiana Program, even though it extends to all 14 community hospitals in that state. It has a number of distinctive features, the most unique being the use of a statewide ceiling on the annual increase in hospital expenditures. This ceiling, termed the Maxicap, is negotiated jointly each year by the Blue Cross plan, the hospital association, and the state government. Although important differences thus exist between the Rhode Island and Indiana programs, they are still basically similar since the Rhode Island system incorporates all the essential characteristics of the Indiana Program.[8]

The same is true for the recently instituted Blue Cross programs in two large states -- Michigan and Florida. Again, there are differences. For example, both the Michigan and Florida programs employ

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[8] The first phase of the Rhode Island program took place in 1971 and 1972. It was this phase that was evaluated by Thornberry and Zimmerman (1976). As noted earlier, they found that the Rhode Island system did not have a significant impact on hospital costs. After a two-year hiatus, the Rhode Island program was reinstituted incorporating a number of significant changes, including the use of the Maxicap. A quantitative study has not yet been conducted analyzing the Rhode Island system's effects after 1974.

primary screens (albeit of a different type) which grant virtually automatic approval to hospitals whose rate requests meet the conditions of the screen. Further, unlike the Florida and Indiana systems, the unit of payment in the Michigan program is the weekly budget aliquot rather than charges. However, the similarities between these programs and the Indiana system are much stronger than their differences. Both the Michigan and Florida systems possess all the essential features of the Indiana Program.

The prospective rate setting program in Northwest Missouri is administered by the Blue Cross plan in Kansas City. Initiated in 1972, this program has steadily evolved in terms of both general expertise and specific techniques. Throughout its history it has received substantial hospital support. The Indiana Program was the explicit model for this program as it was for the Wisconsin and Florida systems, and to a lesser extent, the Michigan program. The Northwest Missouri program thus has all of the Indiana Program's essential characteristics.

Like the Wisconsin and Rhode Island programs, the Minnesota program is a joint public/private enterprise. The state government is the overall rule maker, and the hospital association performs the hospital review function. Although mandated by state law, the Minnesota system was initially a "review and comment" program, relying on the possibility of adverse publicity to ensure hospital compliance. However, adherence to the program's rates was recently made a condition of the Minnesota Blue Cross contract, thereby increasing the compulsory nature of this program. As a result, the Minnesota program now has all the necessary characteristics of the Indiana Program.[9]

Iowa, another of this study's control states, is in the final stages of setting up an experimental program. The model for its proposed system is the Wisconsin program, which as noted earlier resembles the Indiana Program. Accordingly, if established as seems likely and if eventually converted to a permanent program, the Iowa system will also incorporate the essential features of the Indiana Program. The remaining control state, Illinois, does not have either a permanent or experimental program, although systems of different types have been considered by the state legislature during the last several years.

In five states - Washington, Maryland, Colorado, Massachusetts, and Connecticut -- prospective rate setting systems are operated by hospital cost commissions, which are state government units. All these programs lack an essential Indiana Program characteristic: In none

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[9] The first program to stress public disclosure as opposed to other potential sanctions was the Arizona program, which still depends primarily on this deterrent. This program also differs from the Indiana Program in that the private sector's influence is weaker than the government's.

is the private sector's influence at least equal to the government sector's. However, the Washington program has all other necessary features of the Indiana Program. Further, the private sector's influence is stronger in the Washington system than in the other cost commission programs. There is thus substantial similarity between the Indiana and Washington programs.

In contrast, the Massachusetts and Connecticut programs are distinctly dissimilar from the Indiana Program, with one striking difference being the lack of hospital support for these programs. The same is true, although to a lesser extent, for the Maryland program. The Colorado program is still in its formative stages and thus the extent to which it will resemble the Indiana Program is not yet clear.

The prospective rate setting program in Kansas is operated by the Blue Cross plan in that state, while the program in Montana is administered by a nonprofit organization specifically established for this purpose. These systems are analogous to the Washington program, since they have all but one of the Indiana Program's essential characteristics. However, it is not the private sector characteristic that is violated by these programs. Rather, they are voluntary, not compulsory. Even so, they are serious endeavors which contractually bind participating hospitals to program rates and guidelines.

These two programs could thus be transformed relatively easily into systems having all the necessary ingredients of the Indiana Program. In fact, it is the announced intention of the Kansas program to shift to a compulsory basis by 1981. Further, consideration is also being given in Kansas to adopting a course similar to that followed in Wisconsin. That is, the current system would be retained in largely its present form, but would become an explicit three-way partnership involving the state government and the hospital association as well as the program's current administrator, the Blue Cross plan.

Summary

The Indiana Program has many characteristics, all of which may contribute in at least a small way to its success. However, they can be reduced to the following minimum set of features which appear essential to its effectiveness. It is possible that the Program would be equally successful without one or more of these features. However, at the present time elimination of any of these features would seem sufficiently disruptive to threaten the Program's success.

- The Program's announced and actual purpose is to improve the efficiency of hospital care and to thus control hospital costs.

- Adherence to the Program's rates is essentially compulsory for Indiana hospitals.

- The total hospital budget is the binding unit of negotiation.
- Hospitals are paid on the basis of rates established prospectively.
- Sufficient resources are devoted to the Indiana system.
- The Program emphasizes the justifiability of costs from a management perspective and systematically reinforces this emphasis through its periodic review procedures.
- The private sector's influence is at least equal to that of the government sector.
- Substantial and broad-based nonprovider involvement is present.
- The Indiana system has the solid support of individual hospitals.
- The Program's theme is flexibility; its atmosphere is basically informal; and it avoids rigid adherence to bureaucratic procedures.

No factors unique to the Indiana Program or to Indiana block the Program's replicability. The Program is not an Alexander the Great phenomenon: No single individual(s) is so crucial to the Program that it would collapse in his or her absence. Indiana as a state is not an outlier in this country. Rather, Indiana lies within the mainstream of the United States in terms of population, physician characteristics, socioeconomic features, and socio-psychological climate.

Operational prospective rate setting programs with all the Indiana Program's essential features exist in at least seven settings: Wisconsin, Southwest Ohio, Rhode Island, Michigan, Florida, Northwest Missouri, and Minnesota. These areas exhibit a range of characteristics. For example, in terms of population and thus program size, Michigan and Florida are larger than Indiana; Wisconsin and Minnesota are modestly smaller; and Northwest Missouri, Southwest Ohio, and Rhode Island are much smaller. The presence of these programs is concrete evidence of the Program's replicability. In addition, prospective rate setting systems similar to the Indiana Program but lacking one of its essential characteristics are found in Washington, Kansas, and Montana.

It is evident that the replicability of the Indiana Program is substantial. This does not imply that an Indiana-type program is feasible in all states. For example, it may be difficult to establish such a

program in a state marked by rancor between the state government and the hospital industry.

Even so, the central issue is not whether the Program is replicable in all states, but whether it is replicable in most states. The conclusion here is clear: It is eminently possible in most states to set up a prospective rate setting system with the Indiana Program's essential features. Accordingly, based on the Program's impact in Indiana, such systems would probably yield sizeable benefits in other states.

27.
Major Conclusions

The purpose of this study is to produce systematic evidence germane specifically to prospective rate setting and more broadly to hospital cost control. The study achieves this purpose by evaluating the Indiana Program in depth -- an endeavor which yields three types of evidence.

First, this evaluation constitutes a definitive test of the general hypothesis specified in Chapter 1 for prospective rate setting programs. Second, it supplies evidence indicating the potential benefits of the Indiana-type approach to prospective rate setting. Third, it provides important findings generic to prospective rate setting and hospital cost control.

This chapter integrates the study results in terms of this three-dimensional framework. Its discussion of the first two dimensions is succinct since it draws heavily upon Chapters 25 and 26 respectively. Its main task is therefore to address the third dimension of this framework, i.e., to derive from the study findings instructive conclusions generally applicable to the process of controlling hospital costs.

Effectiveness of the Indiana Program

The Indiana Program fulfills the expectations for prospective rate setting which are embodied in the general hypothesis. The Program has a strong negative impact on hospital costs. Its operating expenses are trifling compared to its hospital cost savings. It does not reduce the quality of hospital services or otherwise diminish the effectiveness of hospital care. It does not have other harmful side effects.

The Program's net benefit is unequivocally positive. In 1973, the last main study year, the Program's hospital cost savings exceeded $60 million. During the main study span, 1968 through 1973, its cost savings approximated $200 million. In 1976, the last year included in the time trend analyses, its cost savings range between $80 million and $135 million.

This study clearly demonstrates that a major prospective rate setting program can achieve the results generally expected of such programs. This finding does not imply that all prospective rate setting programs will be successful. Nor does it suggest that most will be effective.

Even so, it provides firm support for the thesis that prospective rate setting can effectively control hospital costs.

During the last decade and especially during the last five years, prospective rate setting has been increasingly embraced by hospitals, Blue Cross plans, legislatures, and government agencies. The accelerating acceptance of this approach has occurred even though there has been little hard evidence supporting its potential benefits. In fact, as noted earlier, previous studies of other prospective rate setting programs have not demonstrated that these programs are successful in controlling hospital costs. This study was designed to partially fill this gap between increasing reliance on prospective rate setting and the dearth of systematic analysis demonstrating its effectiveness.

This project could have found that the Indiana Program has little impact. Had that been the case, its findings would have cast doubt on the wisdom of relying on prospective rate setting to control hospital costs. Instead, the study results indicate that the Indiana Program is an efficient mechanism which controls hospital costs without producing undesirable side effects. The project findings thus provide sustenance to the prospective rate setting approach. In doing so they justify in part the recent shift toward prospective rate setting and encourage further movement in that direction in the future.

Generalizability of the Study Findings To Other Programs

The Indiana Program represents a distinct type of prospective rate setting. Its success in Indiana directly supports the efficacy of this approach to hospital cost control. That is, the study findings can be partially generalized to programs elsewhere which resemble the Indiana Program.

The previous chapter identifies the features of the Indiana Program which appear essential for its success. Programs with these features are sufficiently similar to the Indiana Program that the study findings provide a firm basis for predicting their success. Such programs are now operating in at least seven settings -- Wisconsin, Southwest Ohio, Rhode Island, Michigan, Florida, Northwest Missouri, and Minnesota. The success of the Indiana Program implies that these programs may be successful. The study findings do not assure their success, but they furnish hard evidence indicating their potential benefits.

Further, the project results provide less firm but still appreciable support to programs which resemble the Indiana Program but which lack one of its essential features. Such programs now exist in Washington, Kansas, and Montana.

Because of its effectiveness inside Indiana and its replicability outside Indiana, the Program is likely to continue to serve as a model

for the development of prospective rate setting programs. Presuming that these future programs possess the Program's essential characteristics, the study findings will also be partially generalizable to these programs. That is, as with existing Indiana-type programs, the effectiveness of the Indiana Program constitutes a sound rationale for expecting these future programs to be successful, although it will not ensure such success.

However, the cloak of this study does not extend to all prospective rate setting programs. The New York program is a case in point.[1] It lacks many essential Indiana Program characteristics. The New York program does not establish rates based on total budget review; it does not emphasize the justifiability of costs; it does not have substantial private sector involvement; it does not have solid hospital support; and at a minimum, its theme is not flexibility.

Because of the marked differences between the New York and Indiana programs, the study results cannot be partially generalized to the New York program. This study thus does not furnish evidence suggestive of the New York program's success. This does not imply that the New York program is not successful; it may be. However, as discussed earlier, its success is not demonstrated by either Cromwell or Dowling.

Nor is the Program's effectiveness generalizable to all hospital cost control efforts. For example, the success of the Indiana Program does not suggest that the Economic Stabilization Program was effective in controlling hospital costs. The reverse is in fact implied by the study findings since during the ESP years the cost differences between Indiana and control hospitals did not narrow, but rather continued to widen.

Generic Findings

Centrality of the Labor Sector. The crucial importance of the labor sector to prospective rate setting arises from the arithmetic of hospital costs. As an approximation, labor cost, supply/service cost, and capital cost comprise respectively 60%, 33%, and 7% of total cost. In 1973 the Indiana Program reduced total cost by 10% -- an appropriate objective for other prospective rate setting programs.

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[1] The New York program is the prospective rate setting system most divergent from the Indiana Program. It is consequently used to illustrate the point that there are definite limits on the generalizability of the study findings. However, other programs are sufficiently dissimilar from the Indiana Program that the study results do not provide grounds indicative of their potential benefits. Examples are the Massachusetts, Connecticut, and New Jersey programs.

To achieve this objective solely by impacting labor cost requires reducing this cost by 17% -- a goal clearly within the realm of possibility. To produce a 10% reduction in total cost exclusively by influencing supply/service cost means decreasing this cost by 30% -- a massive but still conceivable impact, although one likely to disrupt the provision of hospital services. It is manifestly impossible to attain a 10% reduction in total cost by influencing capital cost alone. Even if capital cost is reduced to zero, total cost will fall by only 7%.

The key to hospital cost control is thus the labor sector. If a program decreases labor cost, it is likely to reduce total cost; if it has no influence on labor cost, it is unlikely to significantly lower total cost. An impact on labor cost is thus mandatory for the success of prospective rate setting.

This does not imply that a program's impact on hospital utilization of capital resources cannot trigger a decrease in hospital cost. It can, but only if the impact affects labor utilization as well as capital utilization. For example, elimination of a hospital service may reduce capital cost if the equipment providing the service is sold, but in most instances it will appreciably reduce total cost only if the employees staffing the service are terminated. Reducing the "duplication of hospital services" in a community will thus significantly lower total costs only if labor costs fall as a result. Similarly, limiting the proliferation of hospital services in the future will curb hospital cost inflation only if labor expenses are significantly constrained by this step.

Prospective rate setting programs should thus place highest priority on examining hospital deployment of labor resources. They should emphasize careful scrutiny of such variables as labor productivity, wage level, and skill mix. Conversely, at least in their initial years, they should place less emphasis on the capital area. For example, devising new depreciation methods is less likely to be effective in controlling hospital costs than is developing a system for evaluating personnel requirements.

The centrality of the labor sector means that effective control of hospital costs entails tough trade-offs. There is no magic basket of expensive and unnecessary inputs which can simply be eliminated, thereby decreasing hospital costs without disrupting the community. As the Indiana Program's experience shows, hospital cost can be reduced, but at a price. The Indiana Program increases labor productivity -- a desirable result from a hospital standpoint, but one perhaps raising unemployment in the community. The Program decreases wage level -- another desirable result from a hospital viewpoint, but one probably considered less desirable by hospital employees.

This tension is well illustrated by the major hospital cost containment bills now pending before Congress. All but the Talmadge bill include

a provision allowing a pass-through for nonsupervisory wage increases. While understandable politically, this provision is highly questionable from the standpoint of controlling hospital costs.

Failure of the Planning Component. An explicit deficiency of the Indiana Program is that it does not appreciably influence the hospital's capital sector. This shortcoming does not prevent the Program from substantially impacting total cost, thus showing that it is not necessary to influence capital cost in order to reduce total cost. Even so, the lack of impact on hospital capital utilization constitutes a significant Program failure since it is the Program's serious intent to influence hospital deployment of capital resources.

Like other prospective rate setting programs, the Indiana Program retains the review of capital financing and accounting practices, but it delegates to planning agencies the more important function of determining whether proposed capital projects are appropriate. The study findings indicate that Indiana planning agencies did not perform this function effectively. They were not successful in restraining hospital capital expenditures or capital costs.

The study's Michigan results provide some support for the thesis that planning agencies can control hospital utilization of capital resources. Even here the findings are mixed, however. The Michigan planning program did achieve its primary objective: It reduced hospital bed expansion. It did not, however, attain this objective by decreasing hospital capital expenditures. Instead, it altered the mix of hospital capital spending. That is, it shifted capital expenditures from bed construction to other purposes, thereby increasing hospital capital intensity.

Since the last main study year is 1973, the wholesale transformation of planning agencies engendered by Public Law 93-641 is not reflected in the capital sector findings. Further, the ties between planning agencies and the Indiana Program have been strengthened recently, as evidenced by the presence of three HSA-selected members on the Rate Review Committee. It is thus possible that the planning function is now carried out more effectively. However, given the lack of impact during the study years, the burden of proof must rest on the side of demonstrating that this is so. That is, the creation of the HSAs and the cementing of the Program/planning agency relationship do not by themselves ensure that the planning function is now performed effectively.

Efficiency and Effectiveness Gains. Hospital costs can be reduced in two ways. One is by producing the same output at a lower cost. The other is by modifying the nature of output and thereby decreasing cost. The first method entails increasing the efficiency of hospital care, while the second necessitates changing the effectiveness of care. Accordingly, these methods of lowering hospital cost are termed respectively efficiency and effectiveness gains.

Consistent with its objectives, the Program's cost impact is a pure efficiency gain. The Program lowers cost by 10%, but there is no evidence that it influences effectiveness. Its effects on quality, case intensity, and service mix are uniformly insignificant.

The Program's performance graphically illustrates that sizeable cost reductions can be achieved through efficiency gains alone. It is not necessary to change the nature of output to lower hospital cost. Costs can be substantially decreased simply by operating hospitals more efficiently.

Equally significant, large cost reductions can be attained through the actions of the administrative staff alone. Like other prospective rate setting programs, a significant characteristic of the Indiana Program is the peripheral involvement of physicians. Yet, despite the Program's distant relationship with physicians, it still exerts a strong negative influence on cost. These findings undercut the contention that without substantial physician support the administrative staff is powerless to effect meaningful cost savings. The experience of the Indiana Program indicates precisely the reverse.

While increasing physician involvement and attaining effectiveness gains may be desirable for a prospective rate setting program, it will prove difficult to achieve these intertwined objectives. At present, attempting to secure effectiveness gains as well as efficiency gains is likely to result in the attainment of neither. Worse yet, the program may reduce the effectiveness of hospital care in unacceptable ways. It thus seems prudent for prospective rate setting programs to focus their efforts on improving the efficiency of hospital care -- a highly manageable goal as demonstrated by the Indiana Program.

In the future it may be possible to achieve sizeable effectiveness gains, i.e., to reduce hospital cost through judicious modification of hospital output. For example, certain treatment patterns might be modified, substantially reducing the length of hospital stay.

Such a step would require strong physician input. One way to secure this input is through close cooperation between prospective rate setting systems and utilization review programs. However, for this approach to succeed it would not only be necessary to increase the links between these programs, a step avoided so far by both types of programs. It would also be necessary for utilization review programs to markedly expand the scope of their efforts. Achieving significant effectiveness gains entails careful balancing of cost and quality considerations. It also requires a concerted effort to affect not only the treatment of outlier cases, but also the customary treatment patterns employed by most physicians.

Professional versus Financial Incentives. To succeed, any regulatory program must change behavior. It is prohibitively expensive to police all the time. It is imperative to police some of the time. Traffic

regulation illustrates these points. Consider the expense of policing each motorist's compliance with a red light, but also consider the red light compliance rate if no citations are issued.

The Indiana Program fits this regulatory model. Its major cost savings are achieved primarily by changing hospital behavior. That is, the Program stimulates hospitals to improve their efficiency (i.e., to stop at red lights of their own volition). Only a modest fraction of its cost savings result from specific program actions (i.e., its citations). Still, the possibility of such citations is a necessary, albeit not a sufficient, factor contributing to its effectiveness.

Beyond the simple possession of "policing power," how does the Indiana system produce desirable changes in hospital behavior? A number of factors are involved, but they can be reduced to two main types -- professional incentives and financial incentives. When the prospective rate setting approach was first developed, it was thought that the reversed financial incentives described in Chapter 1 would be sufficient by themselves to change hospital behavior. For example, Public Law 92-603 authorizes the conduct of prospective rate setting experiments and demonstration projects "to stimulate providers through positive (or negative) financial incentives to use their facilities and personnel more efficiently . . ."

Based on the Indiana Program's experience, this thesis is wrong. Financial incentives make significant contributions to the Program's impact on hospital behavior, but they are not dominant. Professional incentives are clearly more important.

The Indiana system builds on the administrative staff's basic desire as professionals to be efficient managers. It strongly reinforces this desire through its network of professional incentives. Some incentives are primarily educational in nature, e.g., the learning experience arising from periodic budget review. Others have an economic basis, e.g., the building of a good reputation to enhance professional advancement. Others are more psychological in nature, e.g., the gut reaction of an administrator that he/she will "simply not defend that kind of an increase to the Rate Review Committee."

The dominance of professional incentives in the Indiana Program suggests that other prospective rate setting programs are more likely to succeed if they rely on these incentives to induce changes in hospital behavior. Conversely, it implies that programs which depend heavily on financial incentives are less likely to succeed.

This premise poses a particular difficulty for federal cost control efforts, which tend to be large, uniform, and impersonal. All three characteristics discourage the development of favorable professional incentives. In fact, they may foster the growth of perverse professional incentives. As a consequence, federal cost control initiatives ranging from ESP to the Carter proposal to the Talmadge bill generally

rely on financial incentives and restrictions. The Indiana Program's experience suggests that this almost necessary dependence on financial incentives may make it difficult for these federal initiatives to succeed.

Justifiability versus Allowability. As is its intent, this study throws into sharp perspective the differences between prospective rate setting as represented by the Indiana Program and retrospective reimbursement as exemplified by not only the control states but also the Medicare program. One difference is the reversal in financial incentives. As discussed earlier, at least in terms of the Indiana Program this difference is less important than initially expected.

Another difference is that under prospective rate setting the hospital is reviewed in advance, while under retrospective reimbursement it is reviewed after the fact. Strong advantages accrue from this simple difference. As one Indiana Program participant put it:

> When we review, the horse is still in the barn, although there may be big plans for him. When you go back retrospectively, the horse is long gone and somebody has to pay the bill, either the insurers or the hospital. It's as simple as that.

Still another difference is that the Indiana Program emphasizes whether costs are justifiable from an efficiency perspective, while retrospective reimbursement programs usually stress whether certain categories of costs are allowable. This difference is much more important than is commonly realized. The justifiability and allowability approaches are fundamentally different since they are based on sharply divergent rationales. The allowability approach sees the hospital in absolute terms. Certain types of costs are okay; other types are not okay. In contrast, the justifiability approach sees the hospital in relative terms. The number of nurses seems reasonable in this unit, but cannot fewer be used in that unit?

It is easier to employ the allowability approach than the justifiability approach. Successful use of the latter requires knowledge, flexibility, and patience on the part of the program, and willingness to cooperate on the part of the hospital. It is thus easy to understand why programs, especially large ones such as the Medicare program, have elected to stress the allowability approach. However, the ease with which this approach can be used does not overcome its fatal flaw: Its underlying assumption is invalid. Unless the effectiveness of hospital care is drastically reduced, large hospital cost savings cannot be obtained by outlawing certain types of costs. Instead, they can only be achieved by judiciously improving the utilization of resources.

This point is clearly illustrated by labor productivity -- one of the major variables through which the Indiana Program reduces cost. The

problem in the productivity area is not that hospitals are using certain personnel types that they should not be, or that they are instructing their staff to perform tasks that are categorically inappropriate. Instead, the problem is that hospitals have not sufficiently examined and then instituted the multitude of small changes which together will improve labor productivity. For example, labor productivity can often be increased through such steps as changing skill mix in one unit, decreasing personnel in another, and improving working arrangements in a third.

Labor productivity is thus amenable to the justifiability approach, but refractory to the allowability approach. The same point applies to the other major variables which determine the level of total cost. As a result, total cost cannot be appreciably reduced through the allowability approach.

Reliance on the allowability approach thus entails the significant danger that the review program may be lulled to sleep. It may think that it is being a careful watchdog, controlling hospital costs by disallowing certain items. In actuality the reverse may be true. Hospital cost may be escalating at a rapid pace because the program is not significantly impacting the major variables which determine cost. And thus arises the unfortunate paradox of frequent and fretful cost negotiations, while in the background cost inflation continues unabated.

Longevity of the Program. An important question about any program is: Even if the program is successful at a point in time, can it maintain its effectiveness over time? As the analyses demonstrate, the Indiana Program is not a short-lived phenomenon. In 1976, sixteen years after its establishment, the Program continues to be effective in controlling hospital cost.

Further, the Indiana Program has maintained its effectiveness in the face of a series of shocks. Between 1960 and 1976 ESP was instituted and then disbanded; the Medicare and Medicaid programs were established; a national planning agency network supported largely by federal funds was created; and the hospital industry increasingly became a focus of public scrutiny. While some of these developments may have enhanced the Program's effectiveness, its record in controlling hospital costs during this turbulent period is clear evidence of its structural and functional soundness.

A critical factor in the Program's continued success is that it has maintained a long time horizon. It has remained interested in long-term development as well as in short-term success. On an abstract level it seems almost self-evident that any program should try to balance long-term and short-term objectives. In practice, maintaining this balance proves difficult because trade-offs arise. For example, should a program force immediate changes upon a hospital, or should it allow hospital management to improve its expertise more slowly but

more naturally? The first alternative may have a greater cost impact in the current year, but it may be sufficiently disruptive that the second alternative would have a larger cost influence during the succeeding five-year period.

The Indiana Program's longevity is clearly important. It indicates that Indiana-type programs can represent a long-term solution to the hospital cost control problem. However, to attain the Program's longevity, other systems will have to match its ability to balance long-term and short-term considerations. On the one hand, if too much stress is placed on long-term development, the program may never get off the ground. On the other hand, if immediate successes and short-term crises are overemphasized, the program will never develop the coherent approach necessary to improve hospital efficiency.

It is not hopelessly difficult for a program to strike a balance between long-run and short-run considerations. Still, the reality of the problem is evidenced on the long-run side by the inconclusive deliberations of some planning agencies, and on the short-run side by the frenetic activity of some government bodies.

Conflict with Conventional Wisdom. The traditional regulatory model postulates strict separation between the regulator and the regulated industry. It presumes knowledgeability on the part of the regulator, but it eschews past, present, and future relationships between the regulator and the regulated industry, so that it is not clear from whence this knowledgeability comes. It envisions rather formal proceedings where industry and consumers present their cases, with the regulators cross-examining both sides. Upon conclusion of these hearings, the regulators retire to their chambers and eventually reach a decision, which is then handed down to the industry and consumers. In short, the traditional model is directly based on the legal system, with a smattering of economics thrown in.

It has never been established that this model works in any industry.[2] For several reasons it is particularly unlikely to succeed in the

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[2] Jordan (1970) used California as a setting to analyze the effects of airline regulation by the Civil Aeronautics Board; Friedlaender (1969) examined in detail the regulation of surface transportation by the Interstate Commerce Commission; MacAvoy and Noll (1973) investigated the prices of regulated and unregulated services of natural gas pipelines; and Stigler and Friedland (1970) analyzed electric utility regulation. None of these analysts found that regulation had a positive net benefit. In fact, most concluded that the effects of regulation were perverse.

Noll (1971) presents similar but less detailed evidence for a wide range of regulatory programs. He also contrasts the traditional view of regulation with its political economics.

hospital industry. First, the model is too ponderous; it moves too slowly with too much procedure. It is not geared for the flexible application of general guidelines to individual cases -- precisely the activity required in the hospital industry because of the differences among institutions. Second, the key to reducing hospital costs through efficiency gains is to improve hospital management. To accomplish this goal, the regulator must review the hospital at regular and relatively frequent intervals, stressing one issue at one time and another issue at another time. The traditional model is not designed for this purpose. It is better adapted to delivering landmark decisions expected to remain in effect for years.

Third, the hospital industry is highly complex. Hospitals are often large institutions which use an intricate mixture of labor and nonlabor inputs. Hospital output is even more complicated, with each patient receiving a unique set of services conditioned largely, but not entirely, by which of more than 1,000 diagnoses he or she has. To make matters worse, the whole enterprise is invested with the mystical aura peculiar to healing, sickness, health, life, and death.

The net result is twofold. One is that it is difficult for a pure consumer to be an effective hospital regulator. At a minimum the regulators in aggregate must have substantial hospital expertise. The other is that the regulators must enjoy at least begrudging hospital support. Once hospitals decide to subvert the regulatory system, it will be difficult for the regulators to prevent them from doing so. As an IBC executive expresses it: "If hospitals want to beat the system, they can be very ingenious."

Summarizing, from the perspective of hospital regulation what are the fatal defects in the traditional model? First, the model is too rigid and legalistic. Second, there is insufficient provider involvement in the regulatory process. Third, the model is silent on the importance of industry support, but implicitly assumes that such support is unimportant because of the authority vested in the regulators.

To be effective a hospital regulator must correct these defects. If this is done, the resulting revision of the traditional model exhibits features quite similar to those of the Indiana Program. The Program's keynote is flexibility. It has not become hamstrung by legalistic procedure. It is largely a private sector program, but it features substantial and diverse nonprovider involvement. The Program has the solid support of Indiana hospitals, both individually and collectively.

Without question the Indiana Program conflicts with the traditional regulatory model and hence with conventional wisdom. However, it represents a model that is much more likely to succeed in the hospital industry. In fact, the Indiana Program can be viewed as correcting the major defects in the traditional model. Its success in Indiana and its replicability elsewhere are thus not surprising.

Another important difference, subtle in nature, exists between the Indiana Program and the traditional model. The latter is neat. Its lines of authority and procedure are clear-cut, which accounts in part for its rigidity. The former is untidy. As an example. Who appoints the provider members to the RRC? Is it IBC (which has the formal power) or IHA (which exercises the power in reality)? As another: How does one classify the relationship where the Governor appoints a member to a private sector committee which exercises rate control over local and state government hospitals?

The Indiana-type programs in other states are similarly untidy. Consider Wisconsin: Its Rate Review Committee is suspended in space, with approximately equal input from the Blue Cross plan, the hospital association and the state government. Or Rhode Island: Here the important Maxicap is not set by the state government, but rather is jointly negotiated by Blue Cross, the hospital association, and the state government. Or Southwest Ohio: Here the Blue Cross plan and the hospitals have negotiated rates for 35 years with neither party feeling that formal written guidelines are necessary. Or Minnesota: In this state the basic rules are set by the state government, but the program is implemented by the hospital association.

While perhaps an affront to those who value administrative procedure, this lack of tidiness is a key to the Program's success. By its nature an untidy program encourages interchange. It allows negotiation to proceed before positions are hardened. It facilitates the development of compromises which are acceptable to all parties and which all parties are therefore willing to actively support.

Another important property arises from the Program's untidiness. According to a Program participant:

> Our system rests on the mutual confidence of the players. If this confidence were eroded, we would be dead in the water, and we know it.

It is readily evident to all players that there is nothing in the untidy structure of the Indiana Program which ensures this mutual confidence. All players are thus aware that they must work to maintain this confidence. This point may be less obvious in a neat system. It may seem that the tidy structure alone either guarantees or obviates mutual trust. This is false. In a democratic society the effectiveness of all systems -- neat or untidy -- depends in the long run on the mutual confidence of the players. As an Indiana hospital administrator expresses it:

> In our system the relationships are very important. These relationships cannot be legislated. This does not mean that a state program won't work, but it does mean that to work, a state program must strive to create and then maintain the same types of relationships.

Appendices

As is often the case, the appendices in this report are distinctly different. Appendix A derives a behavioral model for hospitals, thus solidifying the study substantive framework. Appendix B contains three types of supporting data: comparison test results, descriptive statistics, and correlation patterns. Appendix C specifies the references included in the report.

A.
Behavioral Model for Hospitals

The purpose of this appendix is to amplify the study substantive framework by developing a behavioral model for hospitals. To accomplish this goal this appendix identifies those generic factors which influence the behavior of hospitals.

An important assumption underlies the hospital behavioral model: Decision makers of all types will act in such a way as to optimize their utility, with utility being defined broadly as the enlightened self-interests of the individuals involved. In a sense this behavioral assumption amounts to a tautology, since utility cannot be measured (contrary to optimistic 19th century expectations) and since utility is usually defined as that which individuals optimize. Nonetheless, this assumption has two important implications.

First, it implies that individuals are optimizing across more than one variable. If this were not the case, the behavioral model could be stated in terms of a single variable, such as profit maximization. Second, stating the assumption in terms of optimizing indicates that decision makers are assumed to be active in their consideration of the trade-offs among different factors.

This appendix begins by considering the important decision makers in the hospital environment. Its next topic is the identification of factors important to these decision makers. Its last subject is the specification of both the detailed and summary hospital objective functions.

Hospital Decision Makers

As with many complex organizations, the hospital is not controlled by a single decision maker or by a single set of decision makers. The hospital administrator has a strong voice in the management of the hospital, especially in routine operating decisions and in judgments affecting the hotel and administrative units. He/she is also highly involved in broader policy decisions, such as those involving the hospital budget and future capital investment.

Another important decision maker in the hospital environment is the board of directors. The perspective of board members is often similar to that of the administrator, but there are important differences in emphases. The hospital board is likely to be especially concerned about the prestige of the hospital in the community, and about the overall financial status of the institution.

Another important group of decision makers within the hospital environment is the physician staff. Physicians are likely to be particularly concerned about the ancillary and nursing units of the hospital. They are likely to have a voice in both short-run operating decisions (such as turnaround times for laboratory tests) and in long-run investment decisions (such as the profile of tertiary care services).

The physician's influence in the hospital arises mainly because he/she is the primary agent ordering hospital services. In a few instances the choice of hospital may be made on the basis of consumer preferences. However, in the great majority of cases the physician chooses the hospital and determines what types of services will be used within the hospital. This point emphasizes the fact that hospital care is a joint product involving both physician services and hospital services.

In short, the physician is sufficiently powerful within the hospital environment that in developing an objective function for hospitals it is necessary to consider the probable preferences of physicians as well as administrators and board members.[1]

Factors Important to Hospitals

Hospital Financial Position

The great majority of hospitals are nonprofit or local government institutions. As a surface argument, this could be construed to indicate that most hospitals do not have the objective of earning a positive net income.[2] However, experience in other industries indicates that obtaining a positive net income is often an objective of nonprofit institutions.[3] Thus, the simple fact that most hospitals

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[1] This point has been recognized for some time by analysts in the hospital area and was studied by Reder (1965). Pauly and Redisch (1973) have especially emphasized the influence of physicians, as discussed later.

[2] In this appendix the hospital's net income is defined as its earnings stream over time as opposed to its annual paper profits, which may vary substantially from year to year because of idiosyncratic factors.

[3] A good example of this point is the contract research industry. A number of research organizations are nonprofit institutions, while a number of others are for-profit institutions. As shown by investigators such as Dickson (1971), the behavior of for-profit and nonprofit research organizations is remarkably similar and varies along dimensions other than the for-profit/nonprofit characteristic.

are nonprofit or local government organizations does not by itself establish that hospitals do not have the goal of having a positive net revenue.

Davis (1972) has especially emphasized the model of hospitals as cash flow maximizers. She contends that hospitals maximize the difference between revenue and out-of-pocket expenses, with the latter defined as operating expenses excluding depreciation costs. She further argues that hospitals will use their short-run profits to finance future investment in additional facilities and services. In support of this model Davis shows that the majority of nonprofit hospitals consistently make a profit.

There is more general agreement among hospital analysts that at a minimum, the net income position of the hospital represents a constraint on hospital decision making. In different models the constraint may be stated as a minimum, but positive, profit level; as a minimum zero profit level; or as a minimum loss point. Regardless of its specific form, the inclusion of an income constraint means that hospital income position is a consideration in hospital decision making.[4]

It is thus probable that at a minimum the net income of the hospital represents a constraint on hospital decision making. Further, it is likely that the net income of hospitals also represents a direct objective of hospital decision makers. Moreover, as both Davis (1972) and Newhouse (1970a) point up, the view that hospitals maximize profits in the short run is not inconsistent with the contention that hospitals place considerable emphasis on service mix, institution size, and quality of services, since hospitals may use short-run profits to finance future investment in service-increasing inputs.

For reasons analogous to those for net income, hospitals are usually interested in improving their financial position in other ways. That is, they place a positive value on other financial considerations. As an example, a hospital may attempt to increase its net worth by seeking funds from philanthropic or tax sources. As another example, a hospital may shift its debt structure in order to improve its working capital position.

Hospital Professional Status

In the middle 1960s several hospital analysts proposed that hospitals operated as output maximizers, either with or without an income

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[4] Analysts specifying an income constraint of some type in their model of hospital behavior include Rice (1966), Newhouse (1970a), Feldstein (1971), Lee (1971), and Klarman (1965). Further, the model proposed by Ingbar and Taylor (1968) implies an income constraint since in their model hospitals seek to recover costs, i.e., price equals average cost.

constraint (Klarman [1965]; Reder [1965]; and Rice [1966]). Further, Feldstein (1971) and Newhouse (1970a) have constructed models in which hospitals optimize a combination of quantity and quality subject to an income constraint.

In assessing the value hospital decision makers place on hospital output, or the quantity of services, it is essential for two reasons to separate quantity from income. First, it has already been hypothesized that net income is one objective of hospital decision makers. Second, a higher output is likely to improve net income.

In the short run, physicians may wish to keep hospital output at a high level since by doing so they may increase their professional rewards. They may also raise their financial remuneration, but this factor is considered separately later in this appendix. Hospital administrators and board members may also be interested in keeping short-run output high, although this contention, independent of the effect of short-run output on income, is uncertain on substantive grounds. Further, in the short run with a fixed plant capacity, the point will naturally be reached where further increases in output are viewed negatively by both the administrative and physician staffs because of the inconvenience and other difficulties involved in treating patients in a crowded institution.

In the long run it is possible that both the physician and administrative staffs will have the objective of increasing the size of the institution and thus the size of hospital output. This may be important to physicians since a large institution may be able to provide services to them and their patients more effectively, although this argument is not compelling. A large institution may be more important to hospital administrators and board members since their incomes and/or prestige may be higher if they are associated with large hospitals.

However, it seems likely that hospital output is a less important objective of hospitals than is hospital service mix. Nonetheless, it also seems probable that hospital output, independent of the effects of output on income, will be a consideration, although not a dominant one; and that hospital output and size will be a more important objective in long-run policymaking than in short-run decision making.

Lee (1971) argues that both the physician and the hospital administrator act to increase the variety, quantity, and complexity of inputs available in the hospital. By doing so, Lee contends that they increase the status of the hospital, in part to attract physicians in the future. Both Newhouse (1970a) and Feldstein (1971) term their models of hospital behavior constrained quantity-quality maximization, but both authors define quality primarily in terms of the number and scope of inputs. Thus, quality in these two authors' models is similar to service mix in this discussion. Moreover, Reder (1965) has also contended that both physicians and hospital administrators act to increase the array of capital facilities.

It seems likely that hospital service mix will be especially important to physicians. As Reder argues, physicians wish to affiliate with hospitals having sophisticated equipment so that they can treat hospital patients for "as wide a range of ailments as their competence (as they judge it) permits." Service mix may also be important to hospital administrators and board members in that their incomes and/or prestige may be higher in hospitals with a wide range of services. Moreover, hospital board members and administrators are likely to view service mix as an important attraction of the hospital in the eyes of physicians.

An additional consideration is that service mix is also likely to be a constraint on hospital operations. If the range of inputs becomes too low, the hospital may lose its accreditation and be forced to substantially modify its practices.

Case mix is also likely to be an important consideration in hospital decision making. It is of greater concern to physicians, who are actually treating the cases, than to hospital administrators. For example, some orthopedic surgeons more highly value treating athletic injuries than handling chronic arthritis. Similarly, for a given money price physicians may prefer to perform certain types of services. The orthopedist may rather perform meniscectomies than apply plaster casts. In addition, even the administrative staff is likely to prefer not to treat certain types of cases, independent of the effects of case mix on hospital income. As an example, stroke patients and patients with pustulant infections are generally not preferred by the administrative staff.

Feldstein (1970b) has emphasized the importance of case mix and patient mix in physician decisions. He concluded that physicians price their services in order to maintain excess demand for their services over time, thus providing a margin for discretion in the selection of medically interesting cases.

The professional quality of hospital services (as opposed to the types of services offered by hospitals) is likely to be another significant consideration in hospital decision making. The professional quality of services is more important to physicians than to hospital administrators or board members. Physicians may suffer substantial disutility if they feel constrained by external pressures and programs to use techniques and approaches with which they do not agree, i.e., to provide what they consider to be lower quality care. The administrative staff may also emphasize the professional quality of services since that may be an important factor in attracting physicians to the hospital. Moreover, the incomes and/or prestige of hospital administrators and board members may be higher in hospitals having a reputation for a high quality of services.

The prestige of the hospital in the professional health community and in the entire community is likely to be an important consideration for hospital board members, administrators, and physicians. It is strongly

related to some of the considerations discussed earlier, such as service mix, professional quality, and net income. As Lee (1971) and Reder (1965) have pointed up, hospital prestige is a factor which can be used as a summary variable to capture a substantial part of the effects of such factors as service mix and size. Thus, factors already included in the model account in large part for hospital prestige.

Nonetheless, additional factors may contribute to hospital prestige and thereby influence hospital decision making. Examples are the desire of some hospitals for community involvement and the willingness of some hospitals to participate in experimental programs. It is therefore appropriate to include a separate prestige factor in the hospital objective function, recognizing that this factor is heavily influenced by other variables.

The administrative staff does not receive the residual from the operation of the hospital as their income. However, it is likely that their income is highly influenced by hospital net income, service mix, output, and other factors discussed above. It is therefore not necessary to formally include the income of the administrative staff in the hospital objective function.

Physician Financial Position

As indicated earlier, Pauly and Redisch (1973) have emphasized the importance of the physician in the hospital environment. They have argued that the physician is the dominant decision maker and that nonprofit hospitals are operated in order to maximize physician incomes.[5] It is not clear that the case for physician dominance is as extreme as stated by Pauly and Redisch. Nonetheless, as discussed earlier, it seems highly likely that on balance the physician may be as important in hospital decision making as the hospital administrator and board members.

A number of factors important to physicians (such as service mix, case mix, professional quality, and quantity) have been discussed earlier in this section. However, other factors important to physicians have not yet been addressed. A key factor of this type is physician net income. Unlike the hospital itself, the physician's practice is similar in many ways to the model firm specified in economics literature, since the great majority of physicians receive as income the residual from the operation of the practice.

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[5] In the Pauly and Redisch model, in a cooperative setting hospitals are operated to maximize the collective income of physicians; in a competitive setting hospitals are managed to maximize the incomes of individual physicians.

Kessel (1958) argued in a conceptual article that physicians are profit maximizers and that they act as discriminating monopolists. In a study examining the appropriateness of different market models for private physician services, Feldstein (1970b) showed that physicians respond to financial incentives. In a study of physician fee levels, Steinwald and Sloan (1974) concluded that the profit maximization model of physician behavior was most consistent with their empirical results. In addition, in a study in a university setting, Maloney (1970) found that physicians respond to financial incentives in the allocation of their time among patient care, teaching, and research activities.

It is thus likely that income is an important consideration for physicians, and thus for hospital decision making. Further, although physician income is usually strongly positive across the relevant range, it is nonetheless appropriate from a rigorous perspective to include a constraint in the hospital objective function that the income of physicians must equal or exceed a minimum level.

It is probable that physicians weight increases in income to a progressively lesser extent as their incomes rise. The rationale is twofold: As income increases, additional demand for income decreases and progressive income taxes take a larger fraction of income. Hence, it is probable that physician utility, in terms of physician income, is a function with a positive first derivative but a negative second derivative.

Newhouse (1970b) emphasized the concept that physicians may strive for a "target income." The postulation here is similar, but not as strong. It is not being argued that the first derivative of utility in terms of income becomes zero within the relevant range, as required by the "target income" hypothesis, but rather that it becomes smaller as income rises.

Like hospitals, but to a lesser extent, physicians also value other financial considerations. For example, the construction of a physician office building by a hospital may financially benefit physicians in ways not directly reflected in the profits of their practices.

Hospital Objective Functions

Placing the factors discussed in the previous section into mathematical formulation yields the hospital objective function shown on the next

page. In this function, factors are defined in such a way that their impact on hospital utility is positive across the relevant range.

$$\text{Optimize } \bar{U}_h = f\ (\bar{I}_h, \bar{M}_h, \bar{Q}_h, \bar{S}_h, \bar{C}_h, \bar{E}_h, \bar{R}_h, \bar{I}_{md}, \bar{M}_{md})$$

subject to

the constraint that $\bar{I}_h \geq$ minimum loss point,

the constraint that $\bar{S}_h \geq$ minimum level,

and the constraint that $\bar{I}_{md} \geq$ minimum level,

where $\bar{U}_h$ = Aggregate utility of hospital decision makers

$\bar{I}_h$ = Net income of hospital

$\bar{M}_h$ = Other financial considerations of hospital

$\bar{Q}_h$ = Quantity of hospital services

$\bar{S}_h$ = Service mix of hospital

$\bar{C}_h$ = Case mix of hospital

$\bar{E}_h$ = Professional quality of hospital services

$\bar{R}_h$ = Prestige of hospital

$\bar{I}_{md}$ = Net income of physicians

$\bar{M}_{md}$ = Other financial considerations of physicians.

It could be argued that a constraint should be included in the objective function that the income of physicians equals or exceeds a minimum level. However, across the relevant range physician income is strongly positive. A constraint of this type is thus not necessary.

The hospital objective function can also be written in a summary form which provides valuable insights. In this form the vectors $\bar{I}_h$ and $\bar{M}_h$ are consolidated into a single hospital financial position vector, $\bar{F}_h$. The vectors $\bar{Q}_h$, $\bar{S}_h$, $\bar{C}_h$, $\bar{E}_h$, and $\bar{R}_h$ are combined into a single hospital professional status vector, $\bar{P}_h$. The remaining two vectors $\bar{I}_{md}$ and $\bar{M}_{md}$, are collapsed into a single physician financial position vector, $\bar{F}_{md}$.

Hence, the summary form of the hospital objective function is as follows:

$$\text{Optimize } \bar{U}_h = f(\bar{F}_h, \bar{P}_h, \bar{F}_{md})$$

subject to

the constraint that $\bar{F}_h \geq$ minimum level,

the constraint that $\bar{P}_h \geq$ minimum level,

and the constraint that $\bar{F}_{md} \geq$ minimum level,

where $\bar{U}_h$ = Aggregate utility of hospital decision makers

$\bar{F}_h$ = Financial position of hospital

$\bar{P}_h$ = Professional status of hospital

$\bar{F}_{md}$ = Financial position of physicians.

The physician staff is likely to be particularly concerned about the vectors $\bar{P}_h$ and $\bar{F}_{md}$, while the administrative staff and the board are likely to be especially interested in the vectors $\bar{F}_h$ and $\bar{P}_h$. However, the administrative staff and board members cannot afford to neglect the vector $\bar{F}_{md}$ or the hospital will no longer be attractive to physicians. Similarly, the physician staff cannot fully overlook the vector $\bar{F}_h$ or the hospital may be placed in such a constrained financial position that it will not be able to provide the services desired by physicians.

Nonetheless, writing the objective function in this way makes it clear that in a number of instances there will be tension between the vectors $\bar{F}_h$ and $\bar{F}_{md}$, i.e., between the administrative staff and the board interested in improving or maintaining the financial position of the hospital, and physicians concerned about increasing or maintaining their financial position. Further, although the administrative staff, board members, and physicians are generally interested in increasing or maintaining the vector $\bar{P}_h$, situations may arise where tension exists between this vector and the two financial vectors, i.e., between the professional status of the hospital and the financial positions of the hospital and/or physician staff.

B.
Supporting Data

COMPARISON TESTS

TABLE B-1

COMPARISON OF STUDY AND NON-STUDY HOSPITALS IN THE INDIANA UNIVERSE

	Correlation Results
Exogenous Variables	
Nonprofit nonchurch control '73	I[1]
Nonprofit nonchurch control '68	I
Church control '73[2]	I
Church control '68[2]	I
Membership in COTH '73[3]	I
Membership in COTH '68	I
JCAH accreditation '73[3]	I
JCAH accreditation '68	I
Physician concentration '70[4]	I
Income level '69[4]	I
Urban population '70[4]	I
White population '70[4]	I
Education level '70[4]	I
Nursing home bed conc. '69	I
Semi-Exogenous Variables	
ECF involvement '73[2]	I
ECF involvement '68[2]	I
Bed size '73[2]	I
Bed size '68[2]	I
Length of stay '73[2]	I
Length of stay '68[2]	-.22
Operations/admission '73	.24
Operations/admission '70	I
Endogenous Variables	
Total cost '73[2]	I
Total cost '68[2]	I
Occupancy rate '73	I
Occupancy rate '68	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.20.

[2] These variables are analogous to the identically-named variables described in Chapter 9 or 11. While the Segment I variables are drawn from Medicare Cost Report data, these comparison variables are based on AHA Survey data.

[3] COTH is the Council of Teaching Hospitals; JCAH is the Joint Commission on Accreditation of Hospitals.

[4] These variables are the same as the identically-named variables described in Chapter 9.

TABLE B-2

COMPARISON OF SEGMENT II AND NON-SEGMENT II HOSPITALS IN THE INDIANA UNIVERSE (COMPARISON TEST A)

	Correlation Results
Exogenous Variables[2]	
Nonprofit nonchurch control '73	I[1]
Nonprofit nonchurch control '68	I
Church control '73	I
Church control '68	I
Membership in COTH '73	I
Membership in COTH '68	I
JCAH accreditation '73	I
JCAH accreditation '68	I
Physician concentration '70	I
Income level '69	.21
Urban population '70	I
White population '70	I
Education level '70	I
Nursing home bed conc. '69	I
Semi-Exogenous Variables[2]	
ECF involvement '73	I
ECF involvement '68	I
Bed size '73	I
Bed size '68	I
Length of stay '73	I
Length of stay '68	I
Operations/admission '73	I
Operations/admission '70	I
Endogenous Variables[2]	
Total cost '73	I
Total cost '68	I
Occupancy rate '73	I
Occupancy rate '68	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.20.

[2] The variables in this table are identical to those in Table B-1.

TABLE B-3

COMPARISON OF SEGMENT II AND NON-SEGMENT II HOSPITALS
IN THE MAIN STUDY SAMPLE
(COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	I[1]	I[2]
Nonprofit control '68	I	I
Church control '73	I	I
Church control '68		
Medical education '73	I	I
Medical education '68	I	I
Medical education % Δ	I	I
Fiscal year '73	I	I
Fiscal year '68	I	I
Physician concentration '73	.22	I
Physician concentration '68	.22	I
Physician concentration % Δ	I	I
General practitioner conc. '73	I	I
General practitioner conc. '68	I	I
General practitioner conc. % Δ	I	I
Private insurance index '70	I	I
Income level '69	.22	I
Urban population '70	I	I
Farm population '70	I	I
Detroit/Chicago location	NA	I
White population '70	I	I
Education level '70	I	I
Pediatric population '70	I	I
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	I
Emergency/outpatient '68	I	I
Emergency/outpatient % Δ	I	I
ECF involvement '73	I	I
ECF involvement '68	I	I
ECF involvement % Δ	I	I
Length of stay '73	I	I
Length of stay '68	I	I
Length of stay % Δ	I	I
Elderly caseload '73	I	I
Elderly caseload '68	I	I
Elderly caseload % Δ	I	I
Bed size '73	I	I
Bed size '68	I	I
Bed size % Δ	I	I

TABLE B-3 (continued)

	Correlation Results	
	Indiana hospitals only	All hospitals
Endogenous Variables[3]		
Total cost '73	I	I
Total cost '68	I	I
Total cost % Δ	I	I
Labor productivity '73	I	I
Labor productivity '68	I	I
Labor productivity % Δ	I	I
Capital productivity '73	I	I
Capital productivity '68	I	I
Capital productivity % Δ	I	I
Average salary '73	I	I
Average salary '68	I	I
Average salary % Δ	I	I
Capital intensity '73	.33	I
Capital intensity '68	I	I
Capital intensity % Δ	I	I
Payroll/cost '73	I	I
Payroll/cost '68	I	I
Payroll/cost % Δ	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.21.

[2] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.17.

[3] These variables are the Segment I variables described in Chapter 9 or 11.

TABLE B-4

COMPARISON OF SEGMENT III AND NON-SEGMENT III HOSPITALS
IN THE INDIANA UNIVERSE
(COMPARISON TEST A)

	Correlation Results
Exogenous Variables[2]	
Nonprofit nonchurch control '73	I[1]
Nonprofit nonchurch control '68	I
Church control '73	.21
Church control '68	.21
Membership in COTH '73	I
Membership in COTH '68	I
JCAH accreditation '73	I
JCAH accreditation '68	I
Physician concentration '70	I
Income level '69	I
Urban population '70	I
White population '70	I
Education level '70	I
Nursing home bed conc. '69	I
Semi-Exogenous Variables[2]	
ECF involvement '73	I
ECF involvement '68	I
Bed size '73	I
Bed size '68	I
Endogenous Variables[2]	
Total cost '73	.22
Total cost '68	I
Occupancy rate '73	I
Occupancy rate '68	I
Length of stay '73	I
Length of stay '68	I
Operations/admission '73	.20
Operations/admission '70	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.20.

[2] The variables in this table are identical to those in Table B-1.

TABLE B-5

COMPARISON OF SEGMENT III AND NON-SEGMENT III HOSPITALS
IN THE MAIN STUDY SAMPLE
(COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	.29	.21
Nonprofit control '70	.29	.23
Church control '73	.25	I[2]
Church control '70	.22	I
Medical education '73	I[1]	I
Medical education '70	I	I
Medical education % Δ	I	I
Fiscal year '73	I	I
Fiscal year '70	I	I
Physician concentration '73	.24	.21
Physician concentration '70	.28	.20
Physician concentration % Δ	I	I
General practitioner conc. '73	I	-.21
General practitioner conc. '70	I	-.19
General practitioner conc. % Δ	-.25	-.17
Private insurance index '70	.28	.22
Income level '69	I	.20
Urban population '70	.22	I
Farm population '70	I	-.20
Detroit/Chicago location	NA	I
White population '70	I	-.17
Education level '70	I	I
Pediatric population '70	.29	I
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	I
Emergency/outpatient '70	I	I
Emergency/outpatient % Δ	I	I
ECF involvement '73	I	I
ECF involvement '70	I	I
ECF involvement % Δ	I	I
Bed size '73	I	I
Bed size '70	I	I
Bed size % Δ	I	I

TABLE B-5 (continued)

	Correlation Results	
	Indiana hospitals only	All hospitals
III-only Endogenous Variables[3]		
Length of stay '73	.22	I
Length of stay '70	I	I
Length of stay % Δ	I	I
Elderly caseload '73	I	I
Elderly caseload '70	I	I
Elderly caseload % Δ	I	I
Other Endogenous Variables[3]		
Total cost '73	.27	I
Total cost '70	I	I
Total cost % Δ	I	I
Labor productivity '73	-.25	-.18
Labor productivity '70	I	I
Labor productivity % Δ	I	I
Capital productivity '73	-.25	I
Capital productivity '70	I	I
Capital productivity % Δ	I	I
Average salary '73	I	I
Average salary '70	.21	I
Average salary % Δ	I	I
Capital intensity '73	.22	I
Capital intensity '70	I	I
Capital intensity % Δ	.26	I
Payroll/cost '73	-.21	I
Payroll/cost '70	I	I
Payroll/cost % Δ	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.21.
[2] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.17.
[3] These variables are the Segment I variables described in Chapter 9 or 11.

TABLE B-6

COMPARISON OF TIME TREND AND NON-TIME TREND HOSPITALS
IN THE MAIN STUDY SAMPLE
(COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	I[1]	I[2]
Nonprofit control '68	I	I
Church control '73	I	I
Church control '68	I	I
Medical education '73	I	I
Medical education '68	I	I
Medical education % Δ	I	I
Fiscal year '73	I	I
Fiscal year '68	I	I
Physician concentration '73	I	I
Physician concentration '68	I	I
Physician concentration % Δ	I	I
General practitioner conc. '73	I	I
General practitioner conc. '68	I	I
General practitioner conc. % Δ	I	I
Private insurance index '70	I	I
Income level '69	I	I
Urban population '70	I	I
Farm population '70	I	I
Detroit/Chicago location	NA	I
White population '70	I	I
Education level '70	I	I
Pediatric population '70	I	I
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	I
Emergency/outpatient '68	I	I
Emergency/outpatient % Δ	I	I
ECF involvement '73	I	I
ECF involvement '68	I	I
ECF involvement % Δ	I	I
Length of stay '73	I	I
Length of stay '68	I	I
Length of stay % Δ	I	I
Elderly caseload '73	I	I
Elderly caseload '68	I	I
Elderly caseload % Δ	I	I
Bed size '73	I	I
Bed size '68	.23	I
Bed size % Δ	I	I

TABLE B-6 (continued)

	Correlation Results	
	Indiana hospitals only	All hospitals
Endogenous Variables[3]		
Total cost '73	I	I
Total cost '68	I	I
Total cost % Δ	I	I
Labor productivity '73	I	I
Labor productivity '68	I	I
Labor productivity % Δ	I	I
Capital productivity '73	I	I
Capital productivity '68	I	I
Capital productivity % Δ	I	I
Average salary '73	I	I
Average salary '68	I	I
Average salary % Δ	I	I
Capital intensity '73	I	I
Capital intensity '68	I	I
Capital intensity % Δ	I	I
Payroll/cost '73	I	I
Payroll/cost '68	I	I
Payroll/cost % Δ	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.21.
[2] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.17.
[3] These variables are the Segment I variables described in Chapter 9 or 11.

TABLE B-7

COMPARISON OF LABOR USAGE AND NON-LABOR USAGE HOSPITALS
IN THE SEGMENT II SAMPLE
(COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	I[1]	I[2]
Nonprofit control '68	I	I
Church control '73	.33	I
Church control '68	.27	I
Medical education '73	I	I
Medical education '68	I	I
Medical education % Δ	I	I
Fiscal year '73	I	I
Fiscal year '68	I	I
Physician concentration '73	.27	I
Physician concentration '68	I	I
Physician concentration % Δ	I	I
General practitioner conc. '73	I	I
General practitioner conc. '68	I	I
General practitioner conc. % Δ	I	I
Private insurance index '70	.27	I
Income level '69	I	I
Urban population '70	I	I
Farm population '70	I	I
Detroit/Chicago location	NA	I
White population '70	I	I
Education level '70	I	I
Pediatric population '70	I	I
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	-.30
Emergency/outpatient '68	I	-.24
Emergency/outpatient % Δ	I	I
ECF involvement '73	I	I
ECF involvement '68	I	.18
ECF involvement % Δ	I	I
Length of stay '73	I	I
Length of stay '68	I	I
Length of stay % Δ	I	-.22
Elderly caseload '73	I	I
Elderly caseload '68	I	I
Elderly caseload % Δ	I	I
Bed size '73	I	I
Bed size '68	I	I

TABLE B-7 (continued)

	Correlation Results	
	Indiana hospitals only	All hospitals
Labor Usage Endogenous Variables[3]		
Average salary '73	I	I
Average salary '68	I	I
Average salary % Δ	I	I
Labor productivity '73	I	I
Labor productivity '68	I	I
Labor productivity % Δ	I	I
Labor cost '73	I	I
Labor cost '68	I	I
Labor cost % Δ	I	-.20
Other Endogenous Variables[3]		
Supply/service cost '73	I	I
Supply/service cost '68	I	I
Supply/service cost % Δ	I	-.18
Capital cost '73	.35	I
Capital cost '68	I	I
Capital cost % Δ	.27	I
Total cost '73	I	I
Total cost '68	I	I
Total cost % Δ	I	-.18
Capital expenditures	.29	I
Bed size % Δ	I	I
Capital intensity '73	I	I
Capital intensity '68	I	I
Capital intensity % Δ	I	I
Capital productivity '73	I	I
Capital productivity '68	I	I
Capital productivity % Δ	I	I
Net worth '73	I[4]	I[5]
Net worth '68	I	I
Net worth % Δ	I	I
Working capital '73	I[4]	I[5]
Working capital '68	I	I
Working capital % Δ	I	I
Profit margin '73	I[4]	I[5]
Profit margin '68	I	I
Profit margin % Δ	I	I
Shared/contracted services '73	I	I
Shared/contracted services '68	I	I
Shared/contracted services % Δ	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; critical value at the Segment II sample size equals ±.27.
[2] Correlation is insignificant at the .05 level in a two-tailed test; critical value at the Segment II sample size equals ±.17.
[3] These variables are the Segment II variables described in Chapter 9 or 15.
[4] Correlation is insignificant at the .05 level in a two-tailed test; the critical value for the financial position sample size equals ±.29.
[5] Correlation is insignificant at the .05 level in a two-tailed test; the critical value for the financial position sample size equals ±.18.

TABLE B-8

COMPARISON OF FINANCIAL POSITION AND NON-FINANCIAL POSITION HOSPITALS IN THE SEGMENT II SAMPLE (COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	I[1]	I[2]
Nonprofit control '68	I	I
Church control '73	I	I
Church control '68	I	I
Medical education '73	I	I
Medical education '68	I	I
Medical education % Δ	I	I
Fiscal year '73	-.47	I
Fiscal year '68	-.50	I
Physician concentration '73	I	I
Physician concentration '68	I	I
Physician concentration % Δ	I	I
General practitioner conc. '73	I	I
General practitioner conc. '68	I	I
General practitioner conc. % Δ	I	I
Private insurance index '70	I	I
Income level '69	I	I
Urban population '70	I	I
Farm population '70	I	I
Detroit/Chicago location	NA	I
White population '70	I	I
Education level '70	I	I
Pediatric population '70	I	-.20
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	I
Emergency/outpatient '68	I	I
Emergency/outpatient % Δ	I	I
ECF involvement '73	I	I
ECF involvement '68	I	I
ECF involvement % Δ	I	I
Length of stay '73	I	I
Length of stay '68	I	I
Length of stay % Δ	I	I
Elderly caseload '73	I	I
Elderly caseload '68	I	I
Elderly caseload % Δ	I	I
Bed size '73	I	I
Bed size '68	I	I

TABLE B-8 (continued)

	Correlation Results	
	Indiana hospitals only	All hospitals
Endogenous Variables[3]		
Labor cost '73	I	I
Labor cost '68	I	I
Labor cost % Δ	I	I
Supply/service cost '73	I	I
Supply/service cost '68	I	-.19
Supply/service cost % Δ	I	I
Capital cost '73	I	I
Capital cost '68	I	I
Capital cost % Δ	I	I
Total cost '73	I	I
Total cost '68	I	I
Total cost % Δ	I	I
Wage level '73	I[4]	I[5]
Wage level '68	I	I
Wage level % Δ	.44	.29
Skill mix '73	I[4]	I[5]
Skill mix '68	I	I
Skill mix % Δ	I	I
Unionization '73	I[4]	I[5]
Unionization '68	I	I
Unionization % Δ	I	I
Average salary '73	I	I
Average salary '68	I	I
Average salary % Δ	I	I
Labor productivity '73	I	I
Labor productivity '68	I	I
Labor productivity % Δ	I	I
Capital expenditures	I	I
Bed size % Δ	I	I
Capital intensity '73	.28	I
Capital intensity '68	I	I
Capital intensity % Δ	I	I
Capital productivity '73	I	I
Capital productivity '68	I	I
Capital productivity % Δ	I	I
Shared/contracted services '73	I	I
Shared/contracted services '68	I	I
Shared/contracted services % Δ	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; critical value at the Segment II sample size equals ±.27.

[2] Correlation is insignificant at the .05 level in a two-tailed test; critical value at the Segment II sample size equals ±.17.

[3] These variables are the Segment II variables described in Chapter 9 or 15.

[4] Correlation is insignificant at the .05 level in a two-tailed test; the critical value for the labor usage sample size equals ±.33.

[5] Correlation is insignificant at the .05 level in a two-tailed test; the critical value for the labor usage sample size equals ±.21.

TABLE B-9

COMPARISON OF SITE VISIT AND NON-SITE VISIT HOSPITALS[1]
IN THE INDIANA UNIVERSE
(COMPARISON TEST A)

	Correlation Results
Exogenous Variables[2]	
Nonprofit control '73	I[3]
Nonprofit control '68	I
Church control '73	I
Church control '68	I
Membership in COTH '73	I
Membership in COTH '68	I
JCAH accreditation '73	I
JCAH accreditation '68	I
Physician concentration '70	I
Income level '69	I
Urban population '70	I
White population '70	I
Education level '70	I
Nursing home bed conc. '69	I
Semi-Exogenous Variables[2]	
ECF involvement '73	I
ECF involvement '68	I
Bed size '73	I
Bed size '68	I
Length of stay '73	I
Length of stay '68	I
Operations/admission '73	I
Operations/admission '70	I
Endogenous Variables[2]	
Total cost '73	I
Total cost '68	I
Occupancy rate '73	I
Occupancy rate '68	I

[1] The site visit hospitals in this test are the 17 randomly-selected Indiana hospitals.

[2] The variables in this table are identical to those in Table B-1.

[3] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.20.

TABLE B-10

COMPARISON OF SITE VISIT AND NON-SITE VISIT HOSPITALS[1]
IN THE MAIN STUDY SAMPLE
(COMPARISON TEST B)

	Correlation Results
Exogenous Variables[3]	
Nonprofit control '73	I[2]
Nonprofit control '68	I
Church control '73	I
Church control '68	I
Medical education '73	I
Medical education '68	I
Medical education % Δ	.24
Fiscal year '73	I
Fiscal year '68	I
Physician concentration '73	I
Physician concentration '68	I
Physician concentration % Δ	I
General practitioner conc. '73	I
General practitioner conc. '68	I
General practitioner conc. % Δ	I
Private insurance index '70	I
Income level '69	I
Urban population '70	I
Farm population '70	I
Detroit/Chicago location	NA
White population '70	I
Education level '70	I
Pediatric population '70	I
Semi-Exogenous Variables[3]	
Emergency/outpatient '73	I
Emergency/outpatient '68	I
Emergency/outpatient % Δ	I
ECF involvement '73	I
ECF involvement '68	I
ECF involvement % Δ	I
Length of stay '73	I
Length of stay '68	I
Length of stay % Δ	-.27
Elderly caseload '73	I
Elderly caseload '68	I
Elderly caseload % Δ	I
Bed size '73	I
Bed size '68	I
Bed size % Δ	I

[1] The site visit hospitals in this test are the 17 randomly-selected Indiana hospitals. They are compared with Indiana hospitals only.

[2] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.21.

[3] These variables are the Segment I variables described in Chapter 9 or 11.

TABLE B-10 (continued)

	Correlation Results
Endogenous Variables[3]	
Total cost '73	I
Total cost '68	I
Total cost % Δ	I
Labor productivity '73	I
Labor productivity '68	I
Labor productivity % Δ	I
Capital productivity '73	I
Capital productivity '68	I
Capital productivity % Δ	I
Average salary '73	I
Average salary '68	I
Average salary % Δ	I
Capital intensity '73	I
Capital intensity '68	I
Capital intensity % Δ	I
Payroll/cost '73	I
Payroll/cost '68	I
Payroll/cost % Δ	I

TABLE B-11

COMPARISON OF CHAPTER 23 AND NON-CHAPTER 23 HOSPITALS IN THE INDIANA UNIVERSE (COMPARISON TEST A)

	Correlation Results
Exogenous Variables[2]	
Nonprofit nonchurch control '73	I[1]
Church control '73	I
Membership in COTH '73	I
JCAH accreditation '73	I
Physician concentration '73	I
Income level '69	I
Urban population '70	I
White population '70	I
Education level '70	I
Nursing home bed conc. '69	I
Semi-Exogenous Variables[2]	
ECF involvement '73	I
Bed size '73	I
Length of stay '73	I
Operations/admission '73	.22
Endogenous Variables[2]	
Total cost '73	I
Occupancy rate '73	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.20.

[2] The variables in this table are described in Table B-1.

TABLE B-12

COMPARISON OF CHAPTER 23 AND NON-CHAPTER 23 HOSPITALS
IN THE MAIN STUDY SAMPLE
(COMPARISON TESTS B AND C)

	Correlation Results	
	Indiana hospitals only	All hospitals
Exogenous Variables[3]		
Nonprofit control '73	I[1]	I[2]
Church control '73	I	I
Medical education '73	I	I
Fiscal year '73	I	I
Physician concentration '73	.28	I
General practitioner conc. '73	I	I
Private insurance index '70	I	I
Income level '69	I	I
Urban population '70	I	I
Farm population '70	I	I
Detroit/Chicago location	NA	I
White population '70	I	I
Education level '70	I	I
Pediatric population '70	I	I
Semi-Exogenous Variables[3]		
Emergency/outpatient '73	I	I
ECF involvement '73	I	I
Length of stay '73	I	I
Elderly caseload '73	I	I
Bed size '73	I	I
Endogenous Variables[3]		
Total cost '73	I	I
Labor productivity '73	I	I
Capital productivity '73	I	I
Average salary '73	I	I
Capital intensity '73	.31	I
Payroll/cost '73	I	I

[1] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.21.
[2] Correlation is insignificant at the .05 level in a two-tailed test; the critical value at this sample size equals ±.17.
[3] These variables are the Segment I variables described in Chapter 9 or 11.

DESCRIPTIVE STATISTICS

TABLE B-13

SEGMENT I EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	COMBINED[1] Mean/S.D.	MICHIGAN[1] Mean/S.D.	TRISTATE[1] Mean/S.D.
Indiana Program	.350/.478	.521/.501	.514/.501
Nonprofit control '73	.614/.488	.588/.494	.580/.495
Nonprofit control '68	.610/.489	.594/.493	.569/.497
Church control '73	.175/.380	.145/.353	.210/.407
Church control '68	.211/.408	.182/.386	.246/.430
Medical education '73	.008/.031	.012/.037	.004/.016
Medical education '68	.008/.025	.010/.029	.004/.017
Medical education % Δ	.030/.380	.060/.383	.014/.373
Fiscal year '73	7.09/3.10	7.33/3.03	6.63/2.83
Fiscal year '68	7.08/3.08	7.35/2.97	6.59/2.83
Physician concentration '73	71.0/33.5	69.1/35.7	71.4/27.2
Physician concentration '68	69.7/27.2	67.8/28.6	70.3/23.6
Physician concentration % Δ	.005/.160	.001/.163	.011/.153
General practitioner conc. '73	25.6/10.3	24.9/9.67	28.4/9.65
General practitioner conc. '68	29.8/10.9	29.3/10.1	32.2/10.7
General practitioner conc. % Δ	-.137/.176	-.146/.189	-.110/.144
Private insurance index '70	82.7/22.3	82.5/23.0	82.9/20.5
Income level '69	9770/1400	9790/1370	9680/1260
Urban population '70	.565/.273	.527/.290	.586/.244
Farm population '70	.094/.089	.087/.080	.108/.094
Detroit/Chicago location	.081/.274	.085/.280	.036/.187
White population '70	.952/.066	.945/.076	.963/.050
Education level '70	11.9/.535	11.9/.509	11.9/.558
Pediatric population '70	.087/.009	.088/.008	.086/.009
Emergency/outpatient '73	.104/.049	.114/.048	.095/.043
Emergency/outpatient '68	.072/.034	.079/.033	.066/.031
Emergency/outpatient % Δ	.539/.612	.558/.655	.542/.587
ECF involvement '73	.078/.237	.065/.211	.064/.214
ECF involvement '68	.053/.191	.030/.145	.056/.199
ECF involvement % Δ	2.28/9.66	2.47/10.1	1.73/7.90
Length of stay '73	7.49/1.37	7.67/1.43	7.25/1.22
Length of stay '68	8.00/1.53	8.02/1.51	7.84/1.48
Length of stay % Δ	-.055/.131	-.035/.136	-.066/.119
Elderly caseload '73	.379/.096	.373/.098	.385/.092
Elderly caseload '68	.379/.105	.366/.099	.392/.104
Elderly caseload % Δ	.023/.187	.037/.145	.003/.194
Bed size '73	194/170	194/176	202/173
Bed size '68	174/155	173/158	176/154
Bed size % Δ	.141/.266	.135/.240	.173/.286

[1] In this and similar tables the Combined statistics are based on data for Indiana and all control hospitals; the Michigan statistics on data for Indiana and Michigan control hospitals; and the Tristate statistics on data for Indiana and Tristate hospitals.

TABLE B-14

SEGMENT I ENDOGENOUS VARIABLES

	COMBINED Mean/S.D.	MICHIGAN Mean/S.D.	TRISTATE Mean/S.D.
Total cost '73	757/283	779/319	685/199
Total cost '68	442/138	445/156	418/111
Total cost % Δ	.720/.346	.760/.360	.653/.299
Nursing cost '73	187/67.2	192/75.3	169/46.2
Nursing cost '68	122/37.4	122/40.0	115/31.8
Nursing cost % Δ	.554/.333	.593/.344	.495/.286
Admin./hotel cost '73	335/116	347/127	303/86.8
Admin./hotel cost '68	200/64.0	204/71.3	187/49.0
Admin./hotel cost % Δ	.693/.368	.731/.400	.640/.334
Ancillary cost '73	179/73.9	184/80.9	163/58.2
Ancillary cost '68	93.7/34.4	94.2/37.4	88.7/31.7
Ancillary cost % Δ	.952/.508	1.00/.520	.883/.478
Labor productivity '73	17.2/4.26	17.1/4.61	18.1/4.18
Labor productivity '68	19.4/4.52	19.4/4.59	20.0/4.44
Labor productivity % Δ	-.099/.176	-.104/.181	-.078/.173
Capital productivity '73	35.9/6.95	36.0/7.06	36.5/7.02
Capital productivity '68	36.9/7.52	37.3/7.62	37.4/7.43
Capital productivity % Δ	-.005/.189	-.018/.184	-.006/.189
Average salary '73	7100/1360	7160/1470	6770/1060
Average salary '68	5100/885	5050/951	4960/797
Average salary % Δ	.404/.204	.433/.227	.377/.179
Capital intensity '73	24800/13500	23400/12200	24800/13800
Capital intensity '68	17500/8480	16500/7990	18600/8940
Capital intensity % Δ	.643/1.34	.705/1.45	.527/1.19
Payroll/cost '73	.575/.047	.574/.047	.570/.044
Payroll/cost '68	.626/.055	.625/.058	.621/.055
Payroll/cost % Δ	-.078/.081	-.077/.082	-.078/.079

TABLE B-15

SEGMENT II EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	COMBINED Mean/S.D.	MICHIGAN Mean/S.D.	TRISTATE Mean/S.D.
Indiana Program	.382/.488	.585/.495	.524/.502
Nonprofit control '73	.604/.491	.564/.499	.600/.492
Nonprofit control '68	.611/.489	.574/.497	.600/.492
Church control '73	.208/.408	.181/.387	.248/.434
Church control '68	.243/.430	.213/.412	.276/.449
Medical education '73	.010/.029	.013/.034	.006/.017
Medical education '68	.007/.020	.009/.023	.004/.011
Medical education % Δ	.203/1.02	.243/1.20	.210/1.10
Fiscal year '73	7.12/3.07	7.30/2.89	6.68/2.89
Fiscal year '68	7.07/3.08	7.27/2.85	6.61/2.89
Physician concentration '73	74.3/32.4	73.8/34.7	73.6/26.9
Physician concentration '68	72.0/26.8	71.5/28.0	72.1/23.9
Physician concentration % Δ	.020/.150	.014/.144	.020/.146

TABLE B-15 (continued)

	COMBINED Mean/S.D.	MICHIGAN Mean/S.D.	TRISTATE Mean/S.D.
General practitioner conc. '73	26.2/10.7	25.7/10.2	28.8/10.1
General practitioner conc. '68	29.9/11.0	29.6/10.1	32.4/11.0
General practitioner conc. % Δ	-.122/.162	-.129/.172	-.104/.142
Private insurance index '70	85.0/21.1	85.4/22.0	84.2/20.3
Income '69	9900/1290	9980/1230	9790/1180
Urban '70	.598/.260	.563/.283	.603/.238
Farm '70	.091/.089	.081/.080	.104/.094
Detroit/Chicago location	.069/.255	.085/.281	.019/.137
White '70	.950/.068	.942/.077	.961/.052
Education '70	12.0/.476	11.9/.476	12.0/.480
Pediatric population '70	.087/.008	.089/.006	.086/.009
Emergency/outpatient '73	.101/.035	.111/.034	.094/.031
Emergency/outpatient '68	.070/.027	.077/.027	.064/.024
Emergency/outpatient % Δ	.509/.500	.531/.522	.551/.522
ECF involvement '73	.018/.055	.013/.048	.016/.051
ECF involvement '68	.016/.056	.004/.023	.020/.063
ECF involvement % Δ	.012/.332	.050/.308	-.018/.334
Length of stay '73	7.26/1.16	7.49/1.16	7.04/1.09
Length of stay '68	7.93/1.17	8.08/1.20	7.75/1.15
Length of stay % Δ	-.080/.104	-.066/.109	-.087/.093
Elderly caseload '73	.377/.091	.371/.092	.384/.088
Elderly caseload '68	.373/.098	.360/.094	.387/.096
Elderly caseload % Δ	.025/.127	.043/.127	.004/.111
Bed size '73	205/168	212/184	206/165
Bed size '68	186/160	191/173	184/156

TABLE B-16

SEGMENT II ENDOGENOUS VARIABLES

	COMBINED Mean/S.D.	MICHIGAN Mean/S.D.	TRISTATE Mean/S.D.
Labor cost '73	418/128	431/143	379/105
Labor cost '68	275/74.2	278/82.1	259/66.9
Labor cost % Δ	.529/.288	.561/.310	.481/.240
Supply/service cost '73	243/73.4	253/81.3	221/58.2
Supply/service cost '68	132/37.3	134/41.4	127/37.5
Supply/service cost % Δ	.875/.403	.929/.437	.794/.346
Capital cost '73	52.0/32.4	53.0/34.5	51.1/30.6
Capital cost '68	29.9/18.2	29.5/20.3	31.1/19.6
Capital cost % Δ	1.22/2.09	1.37/2.35	1.07/1.79
Wage level '73	2.96/.356	3.02/.382	2.86/.274
Wage level '68	2.23/.285	2.29/.329	2.17/.176
Wage level % Δ	.328/.110	.327/.123	.324/.106
Skill mix '73	1.40/.082	1.39/.077	1.41/.079
Skill mix '68	1.38/.080	1.37/.070	1.38/.077
Skill mix % Δ	.017/.031	.014/.029	.017/.031
Unionization '73	1.90/1.95	1.68/1.67	1.65/1.73
Unionization '68	1.51/1.52	1.16/.887	1.52/1.54
Unionization % Δ	.327/1.09	.485/1.37	.079/.342

TABLE B-16 (continued)

	COMBINED Mean/S.D.	MICHIGAN Mean/S.D.	TRISTATE Mean/S.D.
Average salary '73	7060/1050	7170/1110	6830/945
Average salary '68	4980/670	5010/719	4860/630
Average salary % Δ	.424/.167	.435/.156	.413/.174
Capital expenditures	2670/4000	2840/4350	2660/3890
Bed size % Δ	.137/.230	.133/.220	.164/.247
Net worth '73	27600/10400	27600/10500	28000/11100
Net worth '68	21200/7660	20900/7300	21900/7830
Net worth % Δ	.419/.676	.445/.722	.379/.632
Working capital '73	7780/4560	7520/4830	7780/4800
Working capital '68	5910/2930	6130/3190	5850/2850
Working capital % Δ	.601/1.25	.520/1.30	.640/1.33
Profit margin '73	-.026/.056	-.030/.052	-.003/.062
Profit margin '68	-.003/.067	-.004/.058	-.005/.073
Profit margin % Δ	-.976/2.81	-1.14/3.08	-1.09/2.73
Shared/contracted services '73	4.33/1.54	4.21/1.56	4.30/1.55
Shared/contracted services '68	3.72/1.18	3.72/1.25	3.77/1.17
Shared/contracted services % Δ	.184/.353	.145/.309	.155/.326

TABLE B-17

SEGMENT III EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	COMBINED Mean/S.D.
Indiana Program	.308/.464
Nonprofit control '73	.731/.446
Nonprofit control '70	.740/.441
Church control '73	.231/.423
Church control '70	.260/.441
Medical education '73	.011/.029
Medical education '70	.009/.023
Medical education % Δ	.049/.252
Fiscal year '73	7.21/3.49
Fiscal year '70	7.14/3.47
Physician concentration '73	79.1/40.1
Physician concentration '70	77.2/35.1
Physician concentration % Δ	.007/.108
General practitioner conc. '73	23.1/9.28
General practitioner conc. '70	25.9/10.0
General practitioner conc. % Δ	-.093/.157
Private insurance index '70	88.3/20.1
Income level '69	10100/1360
Urban population '70	.613/.278
Farm population '70	.073/.077
Detroit/Chicago location	.115/.321
White population '70	.939/.076
Education level '70	11.9/.513
Pediatric population '70	.089/.008

TABLE B-17 (continued)

	COMBINED Mean/S.D.
Elderly population '73	.099/.023
Elderly population '70	.099/.023
Elderly population % Δ	.006/.040
Emergency/outpatient '73	.110/.041
Emergency/outpatient '70	.084/.032
Emergency/outpatient % Δ	.320/.320
ECF involvement '73	.017/.054
ECF involvement '70	.012/.040
ECF involvement % Δ	.032/.265
Bed size '73	217/157
Bed size '70	207/150

TABLE B-18

SEGMENT III ENDOGENOUS VARIABLES

	COMBINED Mean/S.D.
Case mix '73	1.00/.064
Case mix '70	1.01/.070
Case mix % Δ	-.002/.043
Case severity '73	.934/.158
Case severity '70	.935/.141
Case severity % Δ	.002/.110
Elective surgery '73	.946/.232
Elective surgery '70	.956/.207
Elective surgery % Δ	-.007/.137
Utilization practices '73	1.03/.136
Utilization practices '70	1.04/.134
Utilization practices % Δ	.0002/.091
Elderly caseload '73	.365/.086
Elderly caseload '70	.350/.088
Elderly caseload % Δ	.053/.101
White caseload '73	.948/.044
White caseload '70	.949/.046
White caseload % Δ	-.001/.013
Length of stay '73	7.48/1.23
Length of stay '70	7.77/1.13
Length of stay % Δ	-.037/.087
Quality '73	.965/.155
Quality '70	.939/.172
Quality % Δ	.038/.116
Specialized service mix '73	.261/.220
Specialized service mix '70	.234/.176
Specialized service mix % Δ	.088/.500
Basic service mix '73	.859/.197
Basic service mix '70	.791/.257
Basic service mix % Δ	.164/.327

CORRELATION PATTERNS*

TABLE B-19

SEGMENT I CORRELATIONS BETWEEN THE INDIANA PROGRAM AND EXOGENOUS/SEMI-EXOGENOUS VARIABLES

	Indiana Program		
	Combined Sample	Michigan Sample	Tristate Sample
Exogenous Variables			
Nonprofit control '73	-.17	-.19	-.17
Nonprofit control '68	-.17	-.20	-.14
Church control '73	.02	.12	-.06
Church control '68	.02	.11	-.06
Medical education '73	-.06	-.16	.14
Medical education '68	-.07	-.16	.06
Medical education % Δ	.06	.00	.13
Fiscal year '73	-.10	-.23	.02
Fiscal year '68	-.11	-.25	.02
Physician concentration '73	-.07	-.03	-.13
Physician concentration '68	-.06	-.02	-.13
Physician concentration % Δ	.02	.05	-.02
General practitioner conc. '73	.29	.52	.13
General practitioner conc. '68	.25	.43	.12
General practitioner conc. % Δ	.15	.25	.06
Private insurance index '70	-.01	.00	-.02
Income level '69	-.07	-.11	-.03
Urban population '70	-.09	.02	-.22
Farm population '70	.11	.28	-.01
Detroit/Chicago location	-.22	-.32	-.20
White population '70	.06	.18	-.11
Education level '70	-.02	.04	-.08
Pediatric population '70	.07	-.09	.23
Semi-Exogenous Variables			
ECF involvement '73	-.17	-.20	-.19
ECF involvement '68	-.15	-.11	-.22
ECF involvement % Δ	-.05	-.09	-.02
Emergency/outpatient '73	.01	-.20	.24
Emergency/outpatient '68	-.02	-.22	.19
Emergency/outpatient % Δ	.05	.04	.07
Length of stay '73	-.06	-.22	.10
Length of stay '68	-.14	-.21	-.09
Length of stay % Δ	.11	-.01	.26
Elderly caseload '73	.00	.07	-.06
Elderly caseload '68	-.01	.14	-.14
Elderly caseload % Δ	-.05	-.19	.04
Bed size '73	.07	.09	.05
Bed size '68	.01	.02	.00
Bed size % Δ	.14	.25	.07

* Unless indicated otherwise, all correlations shown in this section refer to the Combined sample of the appropriate segment.

TABLE B-20

SEGMENT I CORRELATIONS AMONG 1973 EXOGENOUS VARIABLES*

	Non-profit	Church	Med. educ.	Fiscal yr.	MD conc.	GP conc.	Pvt. ins.	Income	Urban	Farm	Det/ Chi.	White	Educ.
Church	.37												
Med. educ.	.06	.05											
Fiscal yr.	.06	.18	.15										
MD conc.	.29	.16	.20	.08									
GP conc.	-.33	-.11	-.20	-.09	-.23								
Pvt. ins.	.38	.30	.29	.13	.37	-.33							
Income	.26	.19	.31	.01	.36	-.43	.72						
Urban	.39	.35	.33	.07	.53	-.35	.79	.66					
Farm	-.40	-.28	-.25	-.11	-.45	.52	-.64	-.60	-.72				
Det/Chi.	.14	.06	.36	-.05	.14	-.29	.31	.50	-.39	-.30			
White	-.28	-.21	-.40	-.03	-.28	.34	-.56	-.48	-.63	.52	-.55		
Educ.	.12	.02	.08	-.05	.35	-.21	.44	.52	.37	-.33	.05	-.08	
Ped. pop.	.03	-.03	.07	.02	-.14	-.25	.17	.45	.04	-.11	.06	-.11	.04

*The variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-21

SEGMENT I CORRELATIONS AMONG 1973 SEMI-EXOGENOUS VARIABLES

	Emergency/ Outpatient	ECF Involvement	Length of Stay	Elderly Caseload
ECF Involvement	-.12			
Length of Stay	.01	-.12		
Elderly Caseload	-.10	.26	-.15	
Bed Size	.05	-.23	.46	-.59

TABLE B-22

SEGMENT I CORRELATIONS BETWEEN 1973 SEMI-EXOGENOUS AND EXOGENOUS VARIABLES*

	Emergency/ outpatient	ECF involvement	Length of stay	Elderly caseload	Bed size
Nonprofit control	-.13	-.04	.29	-.23	.32
Church control	-.09	-.12	.16	-.19	.37
Medical education	.17	-.09	.35	-.30	.52
Fiscal year	.01	-.06	.05	-.06	.09
MD concentration	-.02	-.18	.37	-.31	.47
GP concentration	-.12	-.01	-.30	.41	-.30
Pvt. insurance	.02	-.33	.30	-.64	.58
Income level	.12	-.29	.17	-.72	.52
Urban population	-.07	-.29	.35	-.59	.64
Farm population	-.10	.23	-.40	.59	-.53
Detroit/Chicago	.08	-.10	.22	-.28	.19
White population	-.05	.15	-.48	.50	-.50
Education level	.12	-.16	.06	-.33	.30
Pediatric pop.	.12	-.15	-.09	-.44	.11

* The exogenous variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-23

SEGMENT I CORRELATIONS AMONG PERCENTAGE CHANGE EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	Med. educ.	MD conc.	GP conc.	Emer./ outpt.	ECF inv.	Length of stay	Elderly caseload
MD concentration	.03						
GP concentration	-.03	.55					
Emergency/outpt.	-.02	-.02	-.08				
ECF involv.	-.02	-.22	-.21	.00			
Length of stay	.10	.16	-.01	-.09	-.13		
Elderly caseload	-.14	.09	.06	-.05	.26	.26	
Bed size	-.14	-.03	.03	.01	-.02	.11	-.09

TABLE B-24

SEGMENT II CORRELATIONS BETWEEN THE INDIANA PROGRAM AND EXOGENOUS/SEMI-EXOGENOUS VARIABLES

	Indiana Program		
	Combined Sample	Michigan Sample	Tristate Sample
Exogenous Variables			
Nonprofit control '73	-.12	-.09	-.16
Nonprofit control '68	-.14	-.11	-.16
Church control '73	.05	.17	-.03
Church control '68	.02	.12	-.05
Medical education '73	-.09	-.22	.06
Medical education '68	-.12	-.26	.02
Medical education % Δ	.07	.04	.07
Fiscal year '73	-.14	-.30	-.03
Fiscal year '68	-.14	-.31	-.03
Physician concentration '73	-.05	-.05	-.05
Physician concentration '68	-.02	-.01	-.04
Physician concentration % Δ	-.05	-.03	-.08
General practitioner conc. '73	.31	.55	.17
General practitioner conc. '68	.30	.54	.16
General practitioner conc. % Δ	.12	.21	.04
Private insurance index '70	-.04	-.08	-.01
Income level '69	-.05	-.16	.02
Urban population '70	-.15	-.06	-.24
Farm population '70	.09	.29	-.05
Detroit/Chicago location	-.21	-.36	-.15
White population '70	.08	.23	-.08
Education level '70	-.07	.02	-.14
Pediatric population '70	.11	-.08	.23
Semi-Exogenous Variables			
ECF involvement '73	-.18	-.19	-.21
ECF involvement '68	-.18	-.03	-.28
ECF involvement % Δ	.01	-.12	.12
Emergency/outpatient '73	.15	-.14	.42
Emergency/outpatient '68	.01	-.27	.26
Emergency/outpatient % Δ	.19	.22	.16
Length of stay '73	-.02	-.27	.19
Length of stay '68	-.06	-.24	.08
Length of stay % Δ	.06	-.05	.18
Elderly caseload '73	.03	.12	-.04
Elderly caseload '68	.04	.23	-.10
Elderly caseload % Δ	-.06	-.25	.11
Bed size '73	.06	.03	.07
Bed size '68	.02	-.01	.04
Bed size % Δ	.15	.26	.07

TABLE B-25

SEGMENT II CORRELATIONS AMONG 1973 EXOGENOUS VARIABLES*

	Non-profit	Church	Med. educ.	Fiscal yr.	MD conc.	GP conc.	Pvt. Ins.	Income	Urban	Farm	Det/ Chi.	White	Educ.
Church	.42												
Med. educ.	.17	.19											
Fiscal yr.	.05	.22	.17										
MD conc.	.31	.18	.32	.10									
GP conc.	-.22	-.06	-.24	-.10	-.22								
Pvt. ins.	.43	.29	.33	.07	.37	-.34							
Income	.23	.13	.44	-.06	.30	-.45	.74						
Urban	.46	.36	.40	.03	.50	-.41	.79	.66					
Farm	-.40	-.27	-.32	-.09	-.44	.55	-.69	-.65	.73				
Det/Chi.	.11	-.01	.37	-.13	.15	-.27	.30	.45	.37	-.27			
White	-.31	-.26	-.27	.03	-.26	.37	-.56	-.45	-.62	.53	-.61		
Educ.	.09	-.09	.17	-.15	.30	-.20	.42	.48	.35	-.31	-.01	-.02	
Ped. pop.	.00	-.03	.05	.02	-.20	-.28	.19	.48	.04	-.21	.00	-.06	.02

* The variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-26

SEGMENT II CORRELATIONS AMONG 1973 SEMI-EXOGENOUS VARIABLES

	Emergency/ Outpatient	ECF Involvement	Length of Stay	Elderly Caseload
ECF Involvement	-.19			
Length of Stay	.05	-.17		
Elderly Caseload	-.22	.27	-.11	
Bed Size	.13	-.26	.41	-.59

TABLE B-27

SEGMENT II CORRELATIONS BETWEEN 1973 SEMI-EXOGENOUS AND EXOGENOUS VARIABLES*

	Emergency/ outpatient	ECF involvement	Length of stay	Elderly caseload	Bed size
Nonprofit control	.01	-.16	.32	-.22	.34
Church control	-.12	-.14	.26	-.16	.39
Medical education	.08	-.11	.23	-.35	.59
Fiscal year	.01	-.01	.09	-.05	.11
MD concentration	.13	-.16	.37	-.30	.51
GP concentration	-.20	-.01	-.23	.44	-.30
Pvt. insurance	.09	-.38	.36	-.66	.57
Income level	.25	-.36	.24	-.71	.53
Urban population	-.05	-.27	.37	-.58	.64
Farm population	-.16	.22	-.38	.68	-.57
Detroit/Chicago	.02	-.09	.27	-.21	.20
White population	-.04	.15	-.49	.41	-.49
Education level	.19	-.20	.02	-.34	.26
Pediatric pop.	.24	-.20	-.03	-.44	.07

* The exogenous variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-28

SEGMENT II CORRELATIONS AMONG PERCENTAGE CHANGE EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	Med. educ.	MD conc.	GP conc.	Emer./ outpt.	ECF involv.	Length of stay
MD concentration	.09					
GP concentration	-.02	.54				
Emergency/outpt.	.00	-.09	-.10			
ECF involvement	-.04	-.12	-.09	-.04		
Length of stay	.03	.15	-.01	-.17	-.02	
Elderly caseload	.05	.11	.00	-.11	.09	.36

TABLE B-29

SEGMENT III CORRELATIONS BETWEEN THE INDIANA PROGRAM AND EXOGENOUS/SEMI-EXOGENOUS VARIABLES

	Indiana Program
	Combined Sample
Exogenous Variables	
Nonprofit control '73	-.07
Nonprofit control '70	-.08
Church control '73	.13
Church control '70	.08
Medical education '73	-.11
Medical education '70	-.12
Medical education % Δ	.01
Fiscal year '73	-.01
Fiscal year '70	-.03
Physician concentration '73	-.05
Physician concentration '70	-.01
Physician concentration % Δ	-.23
General practitioner conc. '73	.48
General practitioner conc. '70	.49
General practitioner conc. % Δ	.01
Private insurance index '70	.05
Income level '69	-.11
Urban population '70	-.02
Farm population '70	.15
Detroit/Chicago location	-.24
White population '70	.05
Education level '70	-.09
Pediatric population '70	.17
Elderly population '73	-.04
Elderly population '70	-.07
Elderly population % Δ	.20
Semi-Exogenous Variables	
ECF involvement '73	-.12
ECF involvement '70	-.12
ECF involvement % Δ	-.03
Emergency/outpatient '73	-.03
Emergency/outpatient '70	-.06
Emergency/outpatient % Δ	.10
Bed size '73	.04
Bed size '70	.04
Bed size % Δ	.11

TABLE B-30

SEGMENT III CORRELATIONS AMONG 1973 EXOGENOUS VARIABLES*

	Non-profit	Church	Med. educ.	Fiscal yr.	MD conc.	GP conc.	Pvt. ins.	Income	Urban	Farm	Det/ Chi.	White	Educ.	Ped. pop.
Church	.33													
Med. educ.	.13	.15												
Fiscal yr.	-.03	.24	.20											
MD conc.	.16	.09	.20	.11										
GP conc.	-.11	.08	-.21	-.05	-.26									
Pvt. ins.	.13	.20	.35	.15	.15	-.11								
Income	.03	.09	.31	.00	.23	-.31	.69							
Urban	.32	.30	.39	.10	.42	-.25	.79	.63						
Farm	-.25	-.19	-.31	-.14	-.37	.49	-.57	-.57	-.73					
Det/Chi.	.08	.02	.33	-.13	.08	-.29	.34	.50	.42	-.33				
White	-.23	-.16	-.33	-.04	-.16	.29	-.55	-.44	-.64	.53	-.64			
Educ.	-.09	-.12	.11	-.05	.32	-.33	.44	.56	.39	-.48	.00	-.02		
Ped. pop.	-.16	-.04	-.08	.01	-.27	-.04	.06	.35	-.15	.08	-.03	.08	.04	
Elderly pop.	.08	-.02	-.10	-.06	.00	.26	-.50	-.78	-.37	.48	-.23	.26	-.47	-.58

* The variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-31

SEGMENT III CORRELATIONS AMONG 1973 SEMI-EXOGENOUS VARIABLES

	Emergency/ Outpatient	ECF Involvement
ECF Involvement	-.05	
Bed Size	.00	-.28

TABLE B-32

SEGMENT III CORRELATIONS BETWEEN 1973 SEMI-EXOGENOUS AND EXOGENOUS VARIABLES*

	Emergency/ outpatient	ECF involvement	Bed size
Nonprofit control	-.17	-.03	.29
Church control	-.17	-.17	.36
Medical education	.05	-.12	.48
Fiscal year	.03	.05	.08
MD concentration	.02	-.25	.36
GP concentration	-.14	.01	-.25
Pvt. insurance	-.01	-.38	.53
Income level	.18	-.40	.42
Urban population	-.15	-.39	.63
Farm population	-.10	.25	-.54
Detroit/Chicago	.00	-.11	.22
White population	.02	.19	-.44
Education level	.15	-.19	.26
Pediatric pop.	.23	-.11	-.13
Elderly pop.	-.23	.38	-.22

* The exogenous variables in this table are drawn from 1973 or from the only study year for which data was available.

TABLE B-33

SEGMENT III CORRELATIONS AMONG PERCENTAGE CHANGE EXOGENOUS AND SEMI-EXOGENOUS VARIABLES

	Med. educ.	MD conc.	GP conc.	Elderly pop.	Emer./ outpt.
MD concentration	.09				
GP concentration	.06	.35			
Elderly pop.	.11	.35	.14		
Emergency/outpt.	-.13	-.17	.00	-.07	
ECF involvement	-.09	-.11	-.06	-.08	-.01

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